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Nitrogen fertilizer requirements of corn after alfalfa

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Nitrogen fertilizer requirements of corn after alfalfa

by

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GENERAL INTRODUCTION

Alfalfa contributes substantial amounts of N to corn crops that follow, but there is uncertainty concerning the amounts contributed. This causes uncertainty concerning amounts of fertilizer that should be applied to the corn. Such uncertainty is a matter of concern because rates of N fertilization influence both the profitability and the environmental costs of corn production.

Traditional methods of calculating N fertilizer requirements for corn after alfalfa involve estimating the amount of N needed by the corn and then subtracting the amount supplied by the alfalfa. The amounts supplied by the alfalfa are usually calculated by considering fertilizer-N equivalence, which refers to the amount of fertilizer N required to attain yields of continuous corn equal to those attained after alfalfa without fertilization.

Use of the concept of fertilizer N equivalence requires the assumption that corn after corn and corn after alfalfa are directly comparable. Comparisons between the two rotations, however, should be viewed with caution because corn after alfalfa (with or without added N) will often attain higher yields than can be attained by adding N fertilizer to continuous corn. The higher yields are frequently attributed to rotation effects, and it has been suggested that they are due to changes in soil properties, reduction of toxic substances in crop residues, reduction of disease, or release of growth promoters from residues. There is need, therefore, for methods that enable estimation of the N requirements of corn after alfalfa without using the concept of

N equivalence.

Making fertilizer recommendations for corn after alfalfa without using the concept of N equivalence has received little attention. Two new diagnostic tools offer promise for making such recommendations. These are the late-spring soil nitrate test and the end-of-season cornstalk nitrate test, which have been shown to be reliable tools in corn after corn and in corn after soybean. These tools have not been evaluated in corn after alfalfa.

The primary objectives of these studies were (i) to determine optimal rates of N fertilization for first- and second-year corn after alfalfa without the using the concept of fertilizer N equivalence and (ii) to evaluate a soil test based on concentrations of soil nitrate in late-spring for its ability to evaluate N status in first- and second-year corn after alfalfa. The end-of-season cornstalk test was used to help achieve these objectives and was evaluated as a tool that could be used by producers to refine fertilizer N recommendations.

Explanation of Dissertation Format

The dissertation is presented as two papers suitable for publication. Paper I, "Optimal rates of nitrogen fertilization for first-year corn after alfalfa" has been submitted for publication to the *Journal of Production Agriculture*. Paper II, "Evaluation of the late-spring soil nitrate test for use in second-year corn after alfalfa" will be submitted for publication to the *Journal of Production Agriculture*. The two papers are preceded by a General Introduction and succeeded by a General Summary.

PAPER I. OPTIMAL RATES OF NITROGEN FERTILIZATION FOR FIRST-YEAR CORN AFTER ALFALFA

INTRODUCTION

Nitrogen fertilizer recommendations for first-year corn after alfalfa in the Corn Belt are derived by estimating the amounts of N needed by the corn and then subtracting estimates of the amounts of N supplied by the alfalfa (Peterson and Voss, 1984; Welch, 1984). The amounts of N needed by the corn are estimated by multiplying a yield goal and an efficiency factor (often 1.2 lbs N/bu grain) reflecting the N content of the plant at maturity. The amounts of N supplied by the alfalfa are usually calculated by considering fertilizer-N equivalence, which refers to the amount of fertilizer N required to attain yields of continuous corn that are equal to those attained after alfalfa without fertilization.

A major problem associated with making N recommendations by this procedure is that corn after alfalfa (with or without added N) often attains higher yields than can be attained by adding fertilizers to continuous corn. Although this yield difference is often attributed to rotation effects (Higgs et al., 1976; Baldock et al., 1981; Voss and Shrader, 1984a), methods have not been clearly established for calculating fertilizer-N equivalence in the presence of such yield differences. Lack of generally accepted methods undoubtedly accounts for some of the differences in N recommendations among states within the Corn Belt (Kurtz et al., 1984). Methods of making N fertilizer recommendations for corn after alfalfa deserve attention because uncertainty in recommendations seems to be prompting producers to apply substantially more N than is required to attain maximum yields (Daberkow et al., 1988; Legg et al., 1989; El-Hout and Blackmer, 1990).

The objective of this study was to determine economically optimal rates of N fertilization for first-year corn after alfalfa without using the concept of N equivalence. The study also evaluates a soil test based on concentrations of soil nitrate in late spring (Magdoff et al., 1984, 1990; Fox et al., 1989; Blackmer et al., 1989, 1991; Binford et al., 1992a) and a new tissue test based on concentrations of nitrate in cornstalks at the end of the season (Binford et al., 1990, 1992b) for their ability to determine N status in corn after alfalfa. These tests have the ability to evaluate N status in corn after corn and corn after soybeans, but they have not been evaluated in corn after alfalfa.

MATERIALS AND METHODS

Nitrogen response trials were established on 29 fields in northeastern Iowa from 1987 through 1990 (Table 1). Each trial was planted to first-year corn after alfalfa and, except for fertilizer application and grain harvest, was managed by the farmer. Alfalfa management usually consisted of three cuttings/year in all but the establishment year, and no field received a manure application for at least 3 years before corn planting.

The N treatments were 0, 25, 50, 75, 100, 150 and 200 lb N/acre as ammonium sulfate broadcast and incorporated shortly before planting. The treatments were not incorporated at trial three. Plots, which were 40 ft long by 4 or 6 rows wide, were arranged in randomized complete block designs with three replications. The corn was usually planted in the last week of April or the first 10 days of May. Plant populations at harvest ranged from 21,000 to 27,000 plants/acre.

Soil samples were collected when corn was 6 to 12 in. tall; thus sampling usually was complete by the middle of June. Separate composite samples containing eight cores (1.25 in. diameter) were collected from the surface 12-in. layer and from the 12- to 24-in. layer of each plot. The samples were air-dried in a greenhouse in 1987 and 1988 and dried in a forced-air dryer at a temperature of 120°F in 1989 and 1990. The dried soils were crushed to pass a 2-mm sieve and extracted in 2 *M* KCl with a 1:5 soil:extractant ratio. Filtered extracts were analyzed for exchangeable ammonium and nitrate either by the steam distillation procedure of Keeney and Nelson (1982) or by Lachat flow-injection

Table 1. Information describing the soils and crops at each trial in this study.

Trial	Year	Soil Series	Soil Subgroup	Textural class[a]	Soil test[b] pH	Soil test[b] N	Soil test[b] P	Soil test[b] K	Corn Hybrid[c]	Tillage[d]	Starter fertilizer	- Alfalfa - density	- Alfalfa - age
						% N	--ppm--				lb N/a	plant/ft^2	yr
1	87	Fayette	Typic Hapludalf	sil	6.2	0.14	27	78	DK524	SC	6	8.0	5
2	87	Downs	Mollic Hapludalf	sil	6.0	0.31	42	188	P3475	FM	0	5.5	6
3	87	Kenyon	Typic Hapludoll	l	6.8	0.17	16	70	M2360	NT	9	4.5	4
4	87	Downs	Mollic Hapludalf	sil	6.4	0.17	21	114	S2288	SM	9	4.0	4
5	87	Readlyn	Aquic Hapludoll	l	6.1	0.18	34	81	P3475	FM	15	9.0	3
6	87	Readlyn	Aquic Hapludoll	l	6.7	0.24	46	109	DK572	SM	5	5.5	4
7	87	Kenyon	Typic Hapludoll	l	6.7	0.23	6	53	T7020	SM	15	5.5	ND[e]
8	88	Tripoli	Typic Haplaquoll	cl	6.5	0.32	36	143	P3475	FM	10	4.5	ND
9	88	Kenyon	Typic Hapludoll	l	5.7	0.21	16	63	T7500	SM	15	5.5	ND
10	88	Fayette	Typic Hapludalf	sil	6.9	0.16	47	123	P3474	SC	0	2.6	3
11	88	Fayette	Typic Hapludalf	sil	6.7	0.17	30	104	P3569	SM	0	ND	ND
12	88	Downs	Mollic Hapludalf	sil	6.3	0.19	7	70	P3475	SM	8	ND	ND
14	88	Downs	Mollic Hapludalf	sil	6.8	0.15	16	110	P3475	SM	0	ND	ND
15	88	Fayette	Typic Hapludalf	sil	6.5	0.15	12	73	P3475	FC	0	ND	ND
16	88	Downs	Mollic Hapludalf	sil	6.5	0.20	25	110	P3475	FC	10	ND	ND
17	89	Downs	Mollic Hapludalf	sil	6.1	0.20	50	138	P3475	SM	0	ND	4
18	89	Downs	Mollic Hapludalf	sil	6.9	0.19	30	160	P3475	SM	10	ND	3
19	89	Lindley	Typic Hapludalf	l	00	0.17	00	00	P3475	SC	0	3.8	4
20	89	Downs	Mollic Hapludalf	sil	7.2	0.14	20	92	P3751	SM	0	ND	4
21	89	Readlyn	Aquic Hapludoll	l	5.8	0.26	16	132	DK524	FM	0	ND	4
22	89	Dickinson	Typic Hapludoll	fsl	6.5	0.16	51	220	P3751	SC	0	ND	4
23	90	Readlyn	Aquic Hapludoll	l	7.1	0.25	43	73	P3615	SC	5	ND	3
24	90	Tripoli	Typic Haplaquoll	cl	7.6	0.30	3	96	M3668	SM	0	ND	4
25	90	Kenyon	Typic Hapludoll	l	6.0	0.28	9	78	T7020	SM	18	3.4	5
26	90	Fayette	Typic Hapludalf	sil	6.3	0.13	22	132	C442	SC	0	6.0	4
27	90	Fayette	Typic Hapludalf	sil	5.6	0.18	81	144	DK55	SM	0	5.1	4
28	90	Fayette	Typic Hapludalf	sil	6.4	0.13	23	129	P3475	SM	12	5.0	4
29	90	Downs	Mollic Hapludalf	sil	6.3	0.19	38	126	P3475	SM	0	3.0	5
30	90	Dickinson	Typic Hapludoll	fsl	5.9	0.26	40	112	N4344	FM	0	ND	5

a sil-silt loam, l-loam, sl-sandy loam, cl-clay loam, fsl-fine sandy loam.
b pH using a 1:2 ratio of soil:H_2O; N by Kjeldahl; P using the Bray-1 method; K using the ammonium acetate method.
c D-DeKalb, P-Pioneer, M-Moews, S-Supercross, T-Trelay, C-Crows, N-Northrup King.
d S-Spring, F-fall, C-chisel plow, M-moldboard plow, NT-no till.
e ND-not determined.

analysis (Lachat Instruments, Milwaukee, WI; Methods 12-107-06-2-A).

Cornstalk samples were collected 1 to 3 weeks after physiological maturity (black layer) by cutting the lower stalk 6 and 14 in. above ground level and saving the remaining 8-in. piece. Ten stalks were cut from each plot and dried in a forced-air dryer at 140°F. The dried stalks were ground to pass a 0.5-mm sieve and extracted in 0.025 *M* $Al_2(SO_4)_3$ with a 1:50 tissue to extractant ratio. The filtered extracts had 1 ml of 2 *M* $(NH_4)_2SO_4$ added to each 50 ml of extract to minimize differences in ionic strength. Nitrate determinations of the prepared extracts were performed using an Orion Model 93-07 nitrate specific electrode (Orion Research Inc., Boston MA).

Grain yields were determined by hand-harvesting 25-ft segments of the center two rows of each plot and adjusting to 15.5% moisture content. Relative yields for each treatment are expressed as a percentage of the mean yield of the 50-lb through 200-lb N/acre treatments within a trial. Statistical analysis involved partitioning the sum of squares of the treatment effects using contrasts in the GLM procedure of SAS (SAS Institute, 1988). Quadratic-plateau models were used to describe the relationships between grain yields and fertilizer N within each trial (NLIN procedure, SAS Institute, 1988).

RESULTS

Rainfall amounts differed greatly among the four years of the study (Table 2), and these differences were reflected in grain yields. Mean yields were 171 bu/acre for 19 trials having near-normal or above-normal rainfall during the growing season and 102 bu/acre for 10 trials where rainfall was substantially below normal (Table 3). Trials 24 and 30 received unusual rainfall (more than 3.5 inches) during the week before soil samples were collected in late spring. This rainfall resulted in standing water at trial 24, but the corn showed no visible damage.

Applications of fertilizer significantly increased yields at 6 of the 29 trials when tested using comparisons of control plot yields with mean yields of fertilized plots (Table 3). Analysis of yield response by using the quadratic-plateau model showed a significant increase at only three trials (Table 3). These observations are consistent with many other reports indicating little response to fertilizer N in corn after alfalfa (Gardner and Robertson, 1952; Schmid et al., 1959; Sutherland et al., 1961; Boawn et al., 1963; Shrader et al., 1966; Adams et al., 1970; Higgs et al., 1976; Triplett et al., 1979; Baldock et al., 1981; Asghari and Hanson, 1984; Voss and Shrader, 1984b; Spiertz and Sibma, 1986; Levin et al., 1987; Fox and Piekielek, 1988). The optimal rates of N fertilization were less than would be recommended by current methods as summarized by Peterson and Voss (1984) and Welch (1984); a recommendation of 40 to 145 lbs N/acre would be attained by using a yield goal of 148 bu/acre (the average yield of the fertilized plots), an efficiency factor of 1.2 lbs/bu, and credits of 35 to 140 lbs N/acre for the alfalfa.

Table 2. Rainfall amounts for each trial.

Trial	Total[a]	Normal[b]	April	May	June	July	Aug	Sept
	------------------------			in.	------------------------			
1,2	23.5	23.5	1.7	4.3	2.5	3.9	7.4	3.7
3,4,7	26.3	23.5	2.0	4.5	3.5	3.4	9.3	3.6
5,6	24.2	24.7	2.1	4.5	2.7	4.2	8.2	2.5
8	14.2	24.7	2.3	1.5	2.7	2.2	3.5	2.0
9	14.7	23.5	2.4	1.4	2.0	2.6	2.5	3.9
10-16	12.7	23.5	2.2	0.9	1.4	1.4	3.5	3.4
17-20	19.4	23.5	3.4	3.5	1.8	1.6	5.6	3.5
21-22	16.2	24.7	3.0	2.9	1.7	1.9	1.8	5.0
24,30	38.1	24.7	3.7	5.2	8.8	8.5	10.1	1.9
23,25	27.6	23.5	2.9	4.4	6.3	5.5	7.2	1.2
26-29	24.6	23.5	2.2	5.2	4.9	3.8	7.9	0.6

[a] Total rainfall April to Sept.

[b] Long-term average.

Table 3. Grain yields observed at various fertilizer rates at each trial.

Trial	Yields at various fertilization rates ranging from 0 to 200 lb N/acre								
	0	25	50	75	100	150	200	Contrast no N vs N[a]	QRP model[b]
	bu/acre								
1	166.1	161.7	170.1	167.3	161.6	148.8	161.4	NS[c]	MF
2	175.3	185.4	168.1	182.7	182.3	182.4	169.8	NS	NS
3	127.7	153.8	150.4	135.2	143.3	142.1	145.0	*	NS
4	151.0	145.6	153.0	154.2	151.3	158.1	142.9	NS	MF
5	186.6	197.9	181.7	191.1	189.3	189.6	188.5	NS	NS
6	177.3	180.7	188.9	194.7	187.6	194.2	195.1	NS	NS
7	170.7	168.7	171.9	172.2	176.5	174.2	175.9	NS	NS
8	70.6	79.6	64.9	72.4	67.1	72.8	72.4	NS	NS
9	92.5	110.9	103.6	90.4	103.7	113.0	100.7	*	NS
10	111.0	119.1	128.2	125.5	114.9	126.3	123.1	NS	NS
11	132.2	145.8	140.6	142.7	138.7	138.8	134.3	*	NS
12	127.9	129.7	123.1	126.0	120.6	126.9	125.9	NS	MF
14	83.1	89.4	95.0	89.1	95.2	99.2	83.0	NS	NS
15	130.2	113.5	119.4	114.4	122.8	138.4	126.7	NS	MF
16	112.5	118.1	121.9	116.6	117.3	118.2	124.8	NS	NS
17	180.0	141.9	154.6	169.4	170.4	166.5	164.0	NS	MF
18	186.2	179.4	182.6	177.3	194.6	195.3	186.6	NS	MF
19	141.9	167.6	172.8	174.6	170.8	181.0	186.0	*	*
20	174.7	177.3	169.5	182.1	176.8	196.1	173.5	NS	NS
21	80.1	76.2	70.9	72.2	74.6	72.2	78.5	NS	MF
22	46.2	49.6	45.0	51.0	50.4	52.5	53.5	NS	NS
23	192.1	193.6	191.2	194.3	186.7	185.7	192.5	NS	MF
24	122.1	135.9	143.0	141.9	136.3	149.5	149.0	*	*
25	158.5	165.1	159.2	166.2	164.7	156.6	161.9	NS	NS
26	174.3	166.3	164.5	172.9	180.2	186.5	179.6	NS	NS
27	163.2	163.4	161.1	156.3	167.2	171.0	168.1	NS	NS
28	180.4	177.1	180.2	188.4	183.3	187.4	177.6	NS	NS
29	178.3	191.3	183.8	186.6	182.1	173.7	183.4	NS	NS
30	156.4	163.8	163.4	168.1	164.5	166.5	173.3	*	*
Avg[d]	143.1	146.5	145.6	147.4	147.4	150.5	148.2	*	ND
NR[e]	146.8	146.6	145.6	148.8	148.6	151.0	148.2	NS	ND
R[f]	128.8	146.3	145.6	142.2	142.9	148.5	148.1	*	ND

a Orthogonal comparisons of mean yields of control plots with mean yields of all N treatments.

b Probability of a yield response as determined by using Quadratic-Plateau model. MF = model failed to fit data. ND = not determined.

c NS = not significant; * = significant at $P \leq 0.10$.

d Treatments resulted in a significant linear increase in yields; $P = 0.0003$

e NR = means of 23 sites where the contrast of control vs. N treatments was nonsignificant.

f R = means of 6 sites where the contrast of control vs. N treatments was significant.

The profit or loss resulting from using each fertilization rate across the 29 trials is shown in Table 4, which shows price scenarios that generally bracket prevailing prices for fertilizer, corn grain, and fertilizer application costs in the Corn Belt. The 50-lb rate and all higher rates resulted in net losses at all price scenarios considered. The 25-lb rate provided a profit only when the grain price was relatively high. Rates of 0 and 25 lbs N/acre provided the greatest profit; the most profitable rate depended on assumed cost of fertilization and value of grain.

The average yield increase to applications of fertilizer was statistically significant when tested using comparisons of control plot yields with mean yields of fertilized plots (Table 3). Subdivision of the treatment sum of squares shows that there was a significant linear increase in yields from fertilizer applications (Table 3). The rate of increase, however, is too small to be of interest at prevailing prices of corn and fertilizer.

The observed relationship between stalk nitrate concentrations and relative yields (Fig. 1) indicates that only a few plots had nitrate concentrations less than the range Binford et al. (1992b) found optimal. Data in this figure reflect a strong tendency for stalk nitrate to increase with rates of N application (mean concentrations were 3106, 4828, and 6061 ppm N at 0, 100, and 200 lb N/acre) and, therefore, demonstrate that this tissue test is an effective indicator of N status in the optimal-to-excess range. Because the N status of corn after alfalfa is usually in the optimal-to-excess range, this tissue test has

Table 4. Net returns from N fertilization across the 29 sites at various price scenarios.

	Net Returns from Fertilization[a]			
	Corn at $2.00/bu		Corn at $2.50/bu	
N rate	N at $0.10/lb	N at $0.20/lb	N at $0.10/lb	N at $0.20/lb
lb/acre	----------------------	$/acre	----------------------	
25	-1.20	-0.70	0.50	1.00
50	-5.50	-7.50	-4.25	-6.25
75	-4.40	-8.90	-2.25	-6.75
100	-6.90	-13.90	-4.75	-11.75
150	-5.70	-17.70	-2.00	-14.00
200	-15.30	-32.30	-12.75	-29.75

[a] Application cost of $5.50/acre for $0.10 N (assumes anhydrous ammonia application) and $2.50/acre for $0.20 N (assumes liquid N application).

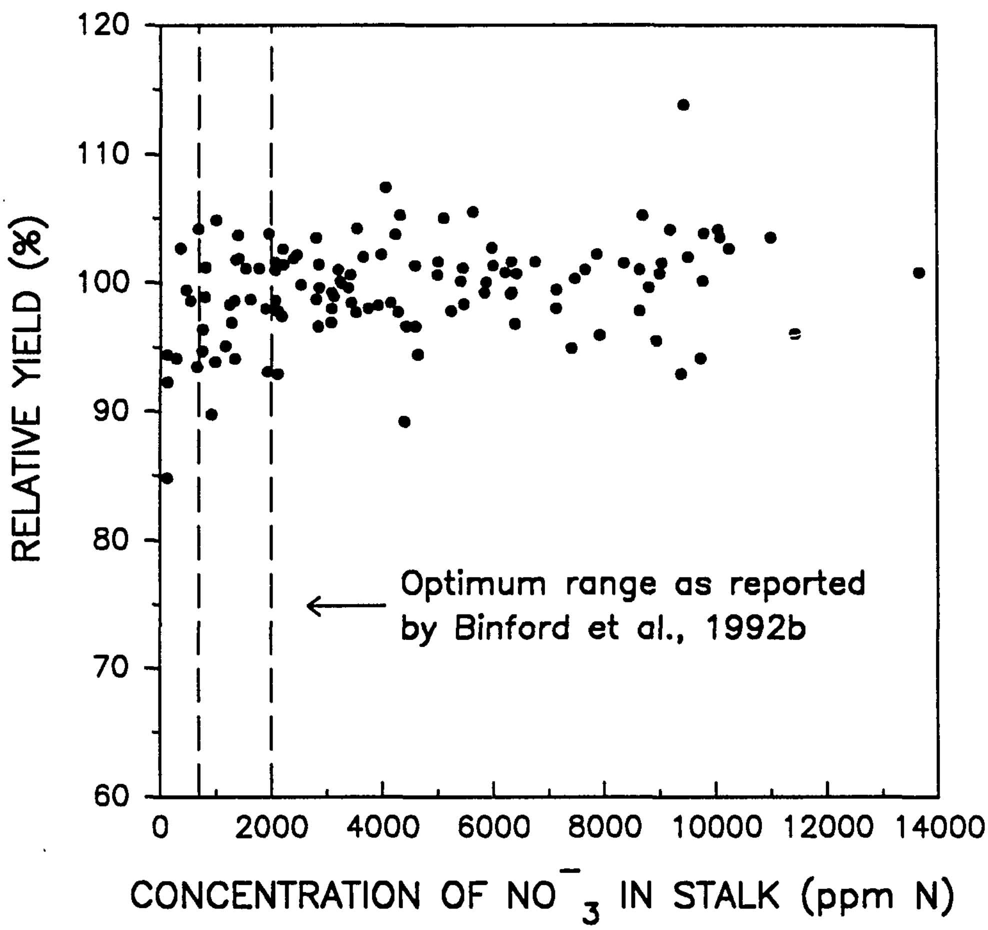

Figure 1. Relationships between relative yields of corn and concentrations of NO_3^- in the lower cornstalk one to three weeks after physiological maturity.

great potential as a tool to help producers identify optimal rates of fertilization for this crop. Other tissue tests lack the ability to assess N status in this range (Fox et al., 1989; Cerrato and Blackmer, 1990, 1991; Schepers et al., 1990; Binford et al., 1992c).

Applications of fertilizer N were detected by the late-spring soil nitrate test, which showed that nitrate concentrations in the 0- to 12-in. layer increased at an average rate of 0.14 ppm/lb N applied (Table 5). Nitrate concentrations in the control plots averaged 23.7 ppm, which is in the middle of the range reported (Binford et al., 1992a) to be optimal for corn after corn and corn after soybean. Evidence that this optimal range is high enough for corn after alfalfa is provided in Fig. 2, which shows the relationship between soil nitrate concentration and relative yield. Because there were so few observations of clear yield responses to applied N, it is impossible to determine whether this optimal range is too high for corn after alfalfa.

Trials 24 and 30 are identified in Fig. 2 because the unusual rainfall at these trials seemed to reduce the reliability of the late-spring soil test. Unusual amounts of rainfall immediately before soil sampling probably promoted losses of nitrate by leaching or denitrification and obscured the usual relationship between concentrations of nitrate and N-supplying power of soils. Obscuring this relationship could be a major problem with corn after alfalfa because of the large potential for mineralization of N after the samples are collected. This problem has only minor impact on the utility of the soil test, however, because sites affected by unusual rainfall can be

Table 5. Late-spring soil nitrate concentrations in the 0 to 12 inch depth in plots receiving various fertilizer treatments in early spring.

	Soil nitrate concentrations at fertilizer rates ranging from 0 to 200 lb N/acre						
Trial	0	25	50	75	100	150	200
	NO^-_3-N ppm						
1	23.5	28.6	30.0	31.6	28.2	45.2	40.6
2	35.1	36.3	42.6	51.9	50.0	58.4	70.8
3	25.6	27.8	30.1	37.9	44.8	57.6	58.5
4	34.8	35.3	47.6	40.7	49.7	50.9	64.8
5	28.0	36.5	37.9	43.7	44.4	53.2	64.5
6	18.2	24.6	26.1	36.4	30.3	38.4	41.5
7	30.5	36.9	40.0	51.1	50.0	56.5	66.2
8	34.3	45.6	41.1	56.1	55.6	57.7	68.5
9	32.6	36.1	40.6	40.6	47.8	45.2	50.4
10	13.2	16.1	26.1	17.6	24.4	24.1	34.9
11	25.0	26.9	32.3	36.3	50.0	30.0	53.5
12	30.7	23.7	27.3	32.0	32.3	39.8	54.2
14	28.2	27.4	31.2	35.8	39.2	40.3	48.6
15	16.1	21.3	24.0	25.7	28.1	42.5	38.6
16	27.8	37.0	40.4	40.9	49.1	47.7	56.2
17	31.6	34.0	32.9	48.1	48.4	60.1	53.6
18	26.3	29.5	43.9	39.7	57.1	57.5	58.8
19	21.6	25.6	29.1	34.3	48.8	50.7	59.2
20	24.7	31.0	34.1	39.3	51.6	45.1	66.7
21	21.9	25.2	28.1	32.3	39.6	37.8	51.9
22	25.2	36.7	36.2	38.5	46.4	41.2	52.4
23	19.8	19.4	33.6	30.7	36.2	44.8	47.2
24	9.4	10.7	14.0	14.0	17.1	22.2	25.1
25	19.6	17.0	22.4	33.3	32.5	35.1	49.6
26	15.5	15.7	16.3	24.6	26.1	32.5	41.0
27	19.7	21.3	33.8	32.0	35.4	36.2	51.2
28	21.5	22.9	31.4	27.8	33.4	49.3	39.2
29	23.8	25.3	34.9	43.6	41.5	48.5	63.7
30	3.1	8.4	11.3	13.2	8.4	9.6	16.6
Mean	23.7	27.0	31.7	35.5	39.5	43.4	51.3

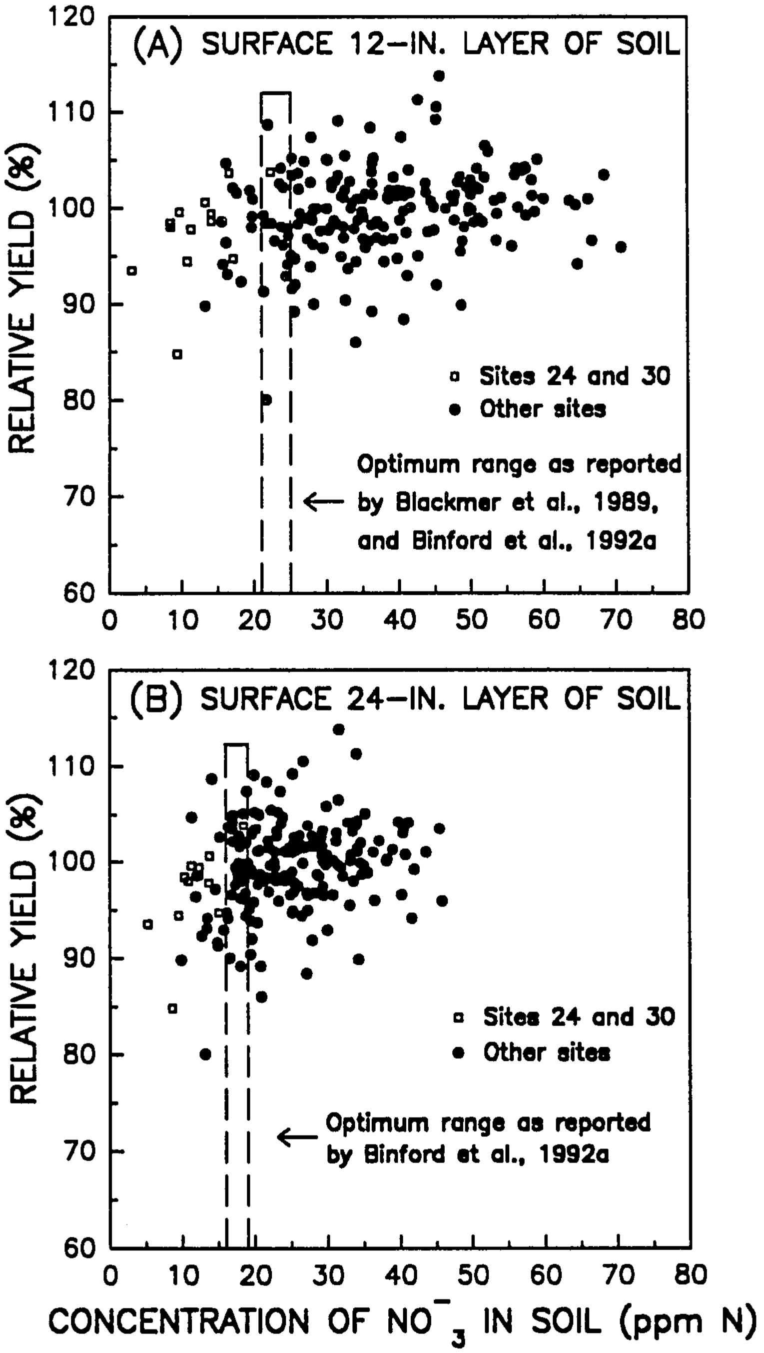

Figure 2. Relationships between relative yields of corn and concentrations of soil NO^-_3 in late spring.

identified before the soils are sampled and the results used with appropriate caution. It also seems likely that modifications of the soil test could improve its performance under such conditions.

Concentrations of nitrate in the 12- to 24-in. layer revealed some evidence for downward movement of nitrate (Table 6), but they increased at a mean rate of only 0.03 ppm for each pound of N applied. Including nitrate from this layer did not significantly improve the performance of the soil test (Fig. 2B). One notable exception is the only sandy soil (site 30, 68% sand) in this study. This trial received unusual amounts of rain in late spring, and the concentrations of nitrate in the second foot of this soil were greater than those in the first foot.

Applications of fertilizer N significantly increased concentrations of exchangeable ammonium at the two depths sampled (Tables 7 and 8). The practical significance of these increases is minimal, however, because the concentrations were small compared with the concentrations of nitrate. Including ammonium in the test did not significantly improve its performance (Fig. 3). The small amounts of ammonium found indicate that nitrification of the fertilizer was essentially complete when the soil was sampled.

Table 6. Late-spring soil nitrate concentrations in the 12 to 24 inch depth in plots receiving various fertilizer treatments in early spring.

	Soil nitrate concentrations at fertilizer rates ranging from 0 to 200 lb N/acre						
Trial	0	25	50	75	100	150	200
	---------------- NO^-_3-N ppm ----------------						
1	6.8	6.9	6.6	8.4	9.9	10.6	18.8
2	15.1	11.4	11.9	15.1	12.5	22.2	20.8
3	10.4	9.8	11.0	14.9	16.8	26.1	19.4
4	10.7	11.1	12.3	12.9	13.2	14.7	18.4
5	10.9	9.8	11.8	12.3	14.0	13.2	11.9
6	7.2	8.0	9.3	12.8	10.5	9.8	13.0
7	15.3	13.9	17.0	20.0	18.2	19.7	20.9
8	14.3	17.6	18.7	24.8	17.3	24.5	20.9
9	6.2	7.2	11.0	13.6	10.3	9.0	13.7
10	6.6	7.6	6.4	18.2	7.0	19.5	9.2
11	13.4	6.9	8.3	14.5	9.7	23.1	8.0
12	4.9	10.1	11.2	9.3	11.3	12.5	14.1
14	4.9	10.0	7.8	18.8	6.7	6.7	19.9
15	6.6	8.6	13.2	13.4	13.4	25.4	12.0
16	11.0	11.3	10.0	17.7	18.0	21.6	23.1
17	8.2	7.6	7.7	7.7	10.3	12.6	10.1
18	8.3	10.1	8.1	10.6	11.0	10.7	11.1
19	4.5	6.6	5.4	5.4	10.1	11.5	11.2
20	4.3	4.4	3.3	4.8	6.0	5.3	13.5
21	6.2	8.5	7.8	9.0	10.1	10.5	11.0
22	4.4	9.4	5.3	6.9	22.6	6.0	7.3
23	ND[a]	ND	ND	ND	ND	ND	ND
24	7.9	8.2	10.6	10.5	12.9	14.7	15.3
25	17.4	17.0	20.6	19.1	24.5	21.3	16.7
26	8.4	11.1	10.5	10.6	11.4	11.9	17.6
27	15.3	15.4	17.1	18.4	15.6	18.4	18.1
28	13.7	10.7	13.3	18.1	11.8	24.8	15.2
29	18.8	14.7	15.4	14.8	17.2	17.6	17.6
30	7.3	13.2	16.0	14.3	12.2	12.8	17.3
Mean	9.6	10.3	11.0	13.5	13.0	15.6	15.2

[a] ND = not determined.

Table 7. Late-spring soil ammonium concentrations in the 0 to 12 inch depth in plots receiving various fertilizer treatments in early spring.

	Soil ammonium concentrations at fertilizer rates ranging from 0 to 200 lb N/acre						
Trial	0	25	50	75	100	150	200
	NH_4^+-N ppm						
1	5.1	4.5	5.4	6.8	9.0	10.8	16.3
2	5.6	4.7	4.9	5.1	7.0	6.8	12.2
3	3.3	5.6	5.9	5.0	6.2	8.1	11.2
4	7.5	6.0	6.5	4.6	5.9	7.6	23.3
5	5.0	4.1	4.9	6.4	5.5	9.3	14.9
6	3.5	3.7	3.7	5.9	5.1	8.3	11.7
7	5.7	6.1	5.5	5.2	6.1	8.1	6.7
8	4.3	4.5	4.0	4.9	5.8	6.1	6.7
9	5.5	9.1	9.8	12.7	12.9	18.3	17.5
10	3.9	4.5	4.1	5.2	4.4	4.1	7.0
11	4.7	5.9	6.2	6.2	8.9	6.7	10.1
12	4.8	4.9	6.5	7.0	4.7	7.3	11.2
14	5.0	5.5	5.1	6.9	6.7	9.6	8.1
15	4.8	4.8	5.4	6.6	5.6	6.5	8.6
16	5.4	5.8	4.8	5.6	5.7	6.4	8.0
17	6.5	5.1	5.8	8.2	7.0	6.6	8.6
18	6.8	7.0	6.0	7.1	13.5	13.8	16.1
19	2.6	2.4	2.5	3.4	4.1	7.8	9.0
20	3.5	2.5	3.4	4.1	5.0	7.6	9.6
21	ND[a]	6.5	6.4	7.1	7.3	11.2	23.5
22	3.9	5.7	5.3	5.4	11.6	18.5	24.0
23	6.0	5.6	5.1	6.1	7.1	5.7	7.8
24	4.8	4.8	4.3	4.2	5.4	5.2	5.5
25	6.7	7.4	8.1	8.4	9.4	9.2	30.5
26	5.3	5.9	6.5	5.8	5.7	5.9	6.2
27	5.5	6.4	7.3	6.7	7.1	12.9	15.7
28	4.5	5.7	6.1	5.7	7.2	11.9	9.3
29	6.9	7.9	8.1	7.9	8.1	9.5	12.6
30	4.9	5.0	8.5	5.1	4.5	5.1	6.1
Mean	5.1	5.4	5.7	6.2	7.0	8.8	12.3

[a] ND - not determined.

Table 8. Late-spring soil ammonium concentrations in the 12 to 24 inch depth in plots receiving various fertilizer treatments in early spring.

	Soil ammonium concentrations at fertilizer rates ranging from 0 to 200 lb N/acre						
Trial	0	25	50	75	100	150	200
	---------------- $NH^{+}{}_{4}$-N ppm ----------------						
1	3.7	4.0	4.5	3.8	5.6	5.0	10.0
2	3.6	3.4	3.6	4.4	5.0	6.4	10.8
3	3.7	3.7	3.4	3.7	5.3	10.1	7.5
4	3.3	6.4	3.9	3.8	4.1	5.1	6.4
5	2.8	3.0	3.3	3.7	4.4	5.6	6.3
6	1.0	1.4	2.0	3.2	3.4	3.5	9.9
7	3.6	4.1	4.0	10.5	6.0	6.4	7.4
8	1.9	2.3	2.3	4.2	2.5	5.8	3.4
9	2.8	5.8	7.2	9.2	8.4	12.2	13.5
10	3.1	2.9	2.5	4.6	2.8	4.9	3.6
11	3.1	3.8	5.7	5.8	4.5	7.4	6.1
12	3.0	4.2	4.0	4.9	5.7	5.3	7.4
14	3.4	3.5	3.9	7.1	3.9	5.1	10.0
15	3.4	3.2	4.4	5.1	4.5	6.3	6.0
16	3.7	4.0	4.3	4.9	4.3	5.5	6.9
17	3.4	3.3	4.0	4.7	4.6	4.1	4.9
18	3.8	4.6	3.3	5.5	6.1	7.2	6.2
19	2.0	2.4	2.0	2.2	2.5	3.2	2.5
20	2.2	2.4	2.4	3.2	2.5	4.2	5.3
21	3.1	4.5	4.7	4.4	5.4	8.1	8.5
22	3.3	4.2	3.1	3.7	14.7	5.2	6.3
23	ND[a]	ND	ND	ND	ND	ND	ND
24	2.4	2.3	2.0	1.5	2.4	2.2	2.8
25	4.8	3.7	4.5	5.4	6.3	6.2	3.7
26	4.8	5.9	3.6	4.5	4.9	4.8	4.6
27	3.7	3.7	4.0	4.3	3.6	5.1	5.5
28	2.9	4.1	3.0	5.0	3.8	7.3	5.5
29	3.9	4.2	4.9	5.0	4.3	5.3	4.4
30	3.0	2.3	4.2	2.3	1.9	2.7	2.7
Mean	3.2	3.7	3.7	4.7	4.8	5.7	6.4

[a] ND = not determined.

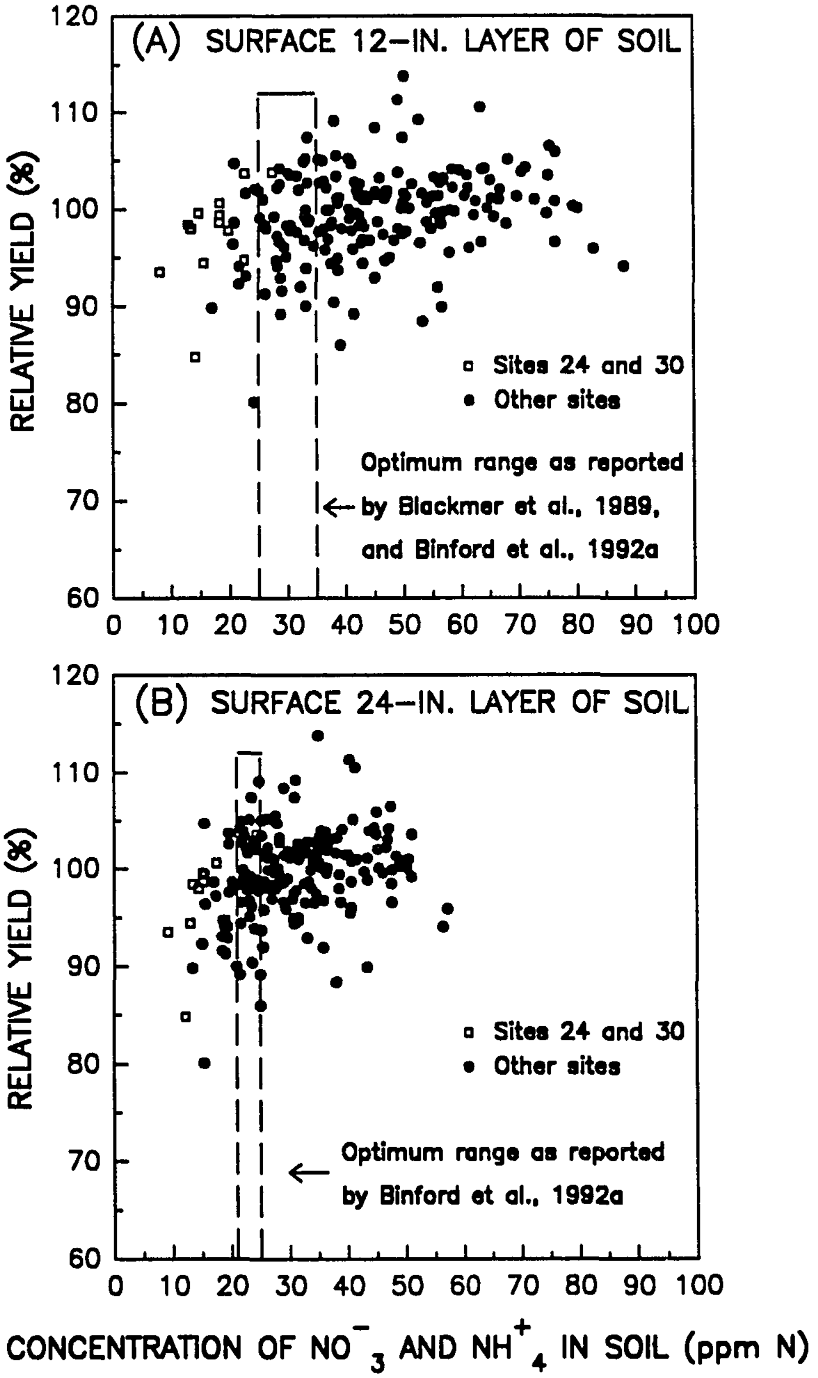

Figure 3. Relationships between relative yields of corn and concentrations of soil NO^-_3 plus exchangeable NH^+_4 in late spring.

CONCLUSIONS

The rate of N fertilization that was most profitable when applied across the 29 fields was mainly determined by price received per unit of grain, price paid per unit of nitrogen fertilizer, and application costs. At prices prevailing in the Corn Belt, applications of 0 and 25 lbs N/acre were the most profitable. The profit-maximizing rates were lower than those indicated by current recommendations based on yield goals, and they were substantially less than the N rates farmers are currently applying.

Uncertainty associated with the N fertilizer requirements of first-year corn after alfalfa could be reduced by considering corn after alfalfa as an independent crop and by not using recommendations based on yield goals, N credits, and the concept of fertilizer equivalence. The soil nitrate test in late spring and the end-of-season cornstalk test should help producers identify situations in which optimal rates are substantially lower than those believed to be optimal. In situations where optimal rates are correctly recognized to be as low as those observed in this study, however, routine use of either test would have little practical value.

LITERATURE CITED

Adams, W.E., H.D. Morris, and R.N. Dawson. 1970. Effect of cropping system and nitrogen levels on corn (*Zea mays*) yields in the southern piedmont region. Agron. J. 62:655-659.

Asghari, M., and R.G. Hanson. 1984. Nitrogen, climate, and previous crop effect on corn yield and grain N. Agron. J. 76:536-542.

Baldock, J.O., R.L. Higgs, W.H. Paulson, J.A. Jackobs, and W.D. Shrader. 1981. Legume and mineral N effects on crop yields in several crop sequences in the upper Mississippi valley. Agron. J. 73:885-890.

Binford, G.D., A.M. Blackmer, and N.M. El-Hout. 1990. Tissue test for excess nitrogen during corn production. Agron. J. 82:124-129.

Binford, G.D., A.M. Blackmer, and M.E. Cerrato. 1992a. Relationships between corn yields and soil nitrate in late spring. Agron. J. 84:53-59.

Binford, G.D., A.M. Blackmer, and B.G. Meese. 1992b. Optimal concentrations of nitrate in cornstalks at maturity. Agron. J. (in press).

Binford, G.D., A.M. Blackmer, and M.E. Cerrato. 1992c. Nitrogen concentration of young corn plants as an indicator of nitrogen availability. Agron. J. 84:219-223.

Blackmer, A.M., D. Pottker, M.E. Cerrato, and J. Webb. 1989. Correlations between soil nitrate concentrations in late spring and corn yields in Iowa. J. Prod. Agric. 2:103-109.

Blackmer, A.M., T.F. Morris, D.R. Keeney, R.D. Voss, and R. Killorn. 1991. Estimating nitrogen needs for corn by soil testing: Iowa 1991. Iowa State Univ. Ext. Pamph. Pm-1381. Coop. Ext. Serv., Ames, IA.

Boawn, L.C., J.L. Nelson, and C.L. Crawford. 1963. Residual nitrogen from NH_4NO_3 fertilizer and from alfalfa plowed under. Agron. J. 55:231-235.

Cerrato, M.E., and A.M. Blackmer. 1990. Relationships between grain nitrogen concentrations and the nitrogen status of corn. Agron. J. 82:744-749.

Cerrato, M.E., and A.M. Blackmer. 1991. Relationships between leaf nitrogen concentrations and the nitrogen status of corn. J. Prod. Agric. 4:525-531.

Daberkow, S., L. Hansen, and H. Vroomen. 1988. Low input practices. p. 22-25. *In* Agric. Outlook No. 148. Econ. Res. Serv., USDA, Washington, D.C.

El-Hout N.M., and A.M. Blackmer. 1990. Nitrogen status of corn after alfalfa in 29 Iowa fields. J. Soil Water Conserv. 45:115-117.

Fox, R.H., and W.P. Piekielek. 1988. Fertilizer N equivalence of alfalfa, birdsfoot trefoil, and red clover for succeeding corn crops. J. Prod. Agric. 1:313-317.

Fox, R.H., G.W. Roth, K.V. Iverson, and W.P. Piekielek. 1989. Soil and tissue nitrate tests compared for predicting soil nitrogen availability to corn. Agron. J. 81:971-974.

Gardner, R., and D.W. Robertson. 1952. The effect of alfalfa on the yields of non-leguminous crops in a rotation. p. 224-228. *In* Proc. Am. Soc. Sugar Beet Techn., Seventh general meeting, Feb. 5-8, 1952, Salt Lake City, Utah.

Higgs, R.L., W.H. Paulson, J.W. Pendelton, A.E. Peterson, J.A. Jackobs, and W.D. Shrader. 1976. Crop rotations and nitrogen: crop sequence comparisons on soils of the driftless area of southwestern Wisconsin 1967-1974. Research Bull. R2761. College of Agric. and Life Sci., Univ. of Wisconsin, Madison, WI.

Keeney, D.R., and D.W. Nelson. 1982. Nitrogen-Inorganic forms. p. 643-698. *In* A. L. Page et al., (ed.) Methods of soil analysis. Part 2. 2nd ed. Agron. Monogr. ASA and SSSA, Madison, WI.

Kurtz, L.T., L.V. Boone, T.R. Peck, and R.G. Hoeft. 1984. Crop rotations for efficient nitrogen production. p. 295-305. *In* R. D. Hauck (ed.) Nitrogen in crop production. ASA, CSSA, and SSSA, Madison, WI.

Legg T.D., J.J. Fletcher, and K.W. Easter. 1989. Nitrogen budgets and economic efficiency: A case study of Southeastern Minnesota. J. Prod. Agric. 2:110-116.

Levin, A., D.B. Beegle, and R.H. Fox. 1987. Effect of tillage on residual nitrogen availability from alfalfa to succeeding corn crops. Agron. J. 79:34-38.

Magdoff, F.R., D. Ross, and J. Amadon. 1984. A soil test for nitrogen availability to corn. Soil Sci. Soc. Am. J. 48:1301-1304.

Magdoff, F.R., W.E. Jokela, R.H. Fox, and G.F. Griffin. 1990. A soil test for nitrogen availability in the Northeastern United States. Commun. Soil Sci. Plant Anal. 21:1103-1115.

Peterson, G.A., and R.D. Voss. 1984. Management of nitrogen in the west central states. p. 722-732. *In* R. D. Hauck (ed.) Nitrogen in crop production. ASA, CSSA, and SSSA, Madison, WI.

SAS Institute. 1988. SAS/STAT User's Guide, Release 6.03 Edition. SAS Institute Inc., Cary, NC.

Schepers, J.S., D.D. Francis, R.B. Ferguson, and R.D. Lohry. 1990. Comparison of early season stem nitrate and leaf total nitrogen concentrations across corn hybrids. Commun. Soil Sci. Plant Anal. 21:1381-1390.

Schmid, A.R., A.C. Caldwell, and R.A. Briggs. 1959. Effect of various meadow crops, soybeans, and grain on the crops which follow. Agron. J. 51:160-162.

Shrader, W.D., W.A. Fuller, and F.B. Cady. 1966. Estimation of a common nitrogen response function for corn (*Zea mays*) in different crop rotations. Agron. J. 58:397-401.

Spiertz, J.H., and L. Sibma. 1986. Dry matter production and nitrogen utilization in cropping systems with grass, lucerne and maize. 2. Nitrogen yield and utilization. Neth. J. Agric. Sci. 34:37-47.

Sutherland, W.N., W.D. Shrader, and J.T. Pesek. 1961. Efficiency of legume residue nitrogen and inorganic nitrogen in corn production. Agron. J. 53:339-342.

Triplett, G.B., Jr., F. Haghiri, and D.M. Van Doren, Jr. 1979. Plowing effect on corn yield response to N following alfalfa. Agron. J. 71:801-803.

Voss, R.D., and W.D. Shrader. 1984a. Rotation effects and legume sources of nitrogen for corn. p. 61-68. *In* D.A. Bezdicek et al. (ed.) Organic farming: Current technology and its role in sustainable agriculture. Spec. Pub. 46. ASA, Madison, WI.

Voss, R.D., and W.D. Shrader. 1984b. Crop rotations: Effect on yields and response to nitrogen. Iowa State Univ. Ext. Serv. Pamph. Pm-905. Coop. Ext. Serv., Ames, IA.

Welch, L.F. 1984. Nitrogen management for the east north central states. p. 708-718. *In* R.D. Hauck (ed.) Nitrogen in crop production. ASA, CSSA, and SSSA, Madison, WI.

PAPER II. EVALUATION OF THE LATE-SPRING SOIL NITRATE TEST FOR USE IN SECOND-YEAR CORN AFTER ALFALFA

INTRODUCTION

A soil test based on nitrate concentrations in late-spring recently has been shown to be a reliable indicator of N status in cornfields (Magdoff et al., 1984, 1990; Fox et al., 1989; Blackmer et al., 1989; Binford et al., 1992a; Meisinger et al., 1992). The test has been evaluated for corn after corn and for corn after soybean, and several states in the humid regions of the U.S. now recommend this soil test to guide N fertilization for these crops.

This soil test was evaluated (in part I of this dissertation) for first-year corn after established alfalfa, a crop that leaves substantial amounts of available N in the soil. This evaluation revealed little need for the soil test if rates of fertilization were in the range of 0 to 25 lbs/acre. The test was not needed because the alfalfa usually supplied sufficient amounts of N to attain maximum yield of first-year corn (Gardner and Robertson, 1952; Schmid et al., 1959; Boawn et al., 1963; Shrader et al., 1966; Adams et al., 1970; Higgs et al., 1976; Baldock et al., 1981; Fox and Piekielek, 1983; Voss and Shrader, 1984; Levin et al., 1987; Fox and Piekielek, 1988). The test was a reliable indicator of N status, however, and its use was recommended for producers who believe it is necessary to apply higher rates of fertilization. Because most producers are in this category, use of the late-spring for first-year corn after alfalfa was shown to have the potential to reduce N rates without reducing profitability.

The soil test has not been evaluated for use in second-year corn after alfalfa, but reports indicate that yield increases from N fertilization are small and variable. Reported yield increases for second-year corn after alfalfa in trials conducted after three or more years of alfalfa, which represent conditions usually found in production agriculture, range from 5 to 28 bu/acre (Gardner and Robertson, 1952; Boawn et al., 1963; Shrader et al., 1966; Shrader, 1973; Fox and Piekielek, 1983; Levin et al., 1987; Fox and Piekielek, 1988). These increases in yield usually occurred from the first increment of fertilizer (usually 40 to 80 lbs N/acre). The relatively small and inconsistent responses to fertilization were usually attributed to variable amounts of N available from the alfalfa. Because of this variability, the late-spring soil test could have great potential for guiding fertilization in second-year corn after alfalfa.

The work reported here was conducted to evaluate the ability of the late-spring soil test to assess N status of fields in second-year corn after alfalfa. The study utilizes a new tissue test to help evaluate the soil test. The tissue test is based on concentrations of nitrate in cornstalks at the end of the season (Binford et al., 1990, 1992b) and is noted for its ability to evaluate N status in the optimal-to-excess range.

MATERIALS AND METHODS

Twenty-four response trials having 10 rates of N (0, 25, 50, 75, 100, 125, 150, 200, 250, and 300 lb/acre) were established in second-year corn after alfalfa in northeastern Iowa from 1988 to 1991. Nitrogen as ammonium sulfate was broadcast and incorporated shortly before planting to plots 40 ft long by four 38-in. rows or six 30-in. rows wide. No fertilizer N was applied to the plots in first-year corn after alfalfa. Randomized complete block designs with three replications were used for all trials.

Except for fertilizer application and grain harvest each trial was managed by producers. The corn was usually planted in late April or in the first half of May (Table 1). Plant populations at harvest ranged from 20,000 to 28,000 plants/acre. The alfalfa had been managed for forage production and usually three cuttings per year were removed in all but the establishment year. All alfalfa stands were three or more years old (average age 4.1 years), and no field had received manure for at least four years before corn planting.

Soil samples were collected when corn plants were 6 to 12 in. tall. Eight separate soil cores (1.25 in. diameter) were collected and composited to produce one soil sample from the surface 12-in. layer and from the 12- to 24-in. layer of each plot. The samples were air-dried in 1988, and dried in a forced-air dryer at a temperature of 120°F from 1989 to 1991. The dried soils were pulverized and passed through a 2-mm sieve. The sieved soil was extracted in 2 *M* KCl using a 1:5 soil:extractant ratio and subsequently analyzed for exchangeable ammonium

Table 1. Information describing soils and crops at each trial in this study.

Trial	Year	Soil Series	Soil Subgroup	Textural class[a]	Corn Hyb[b]	Till[c]	Starter fertilizer	Alfalfa age	Alfalfa density
							lb N/a		plants/ft^2
2	88	Downs	Mollic Hapludalf	sil	P3475	FM	0	6	5.5
3	88	Kenyon	Typic Hapludoll	l	N9292	NT	9	4	4.5
4	88	Downs	Mollic Hapludalf	sil	M4550	FC	9	4	4.0
5	88	Readlyn	Aquic Hapludoll	l	P3475	FM	15	3	9.0
6	88	Tripoli	Typic Haplaquoll	cl	P3475	FM	5	ND[d]	5.5
8	89	Tripoli	Typic Haplaquoll	cl	P3475	FM	10	ND	4.5
9	89	Kenyon	Typic Hapludoll	l	T7500	FC	15	ND	5.5
10	89	Fayette	Typic Hapludalf	sil	L648	FC	0	3	2.6
11	89	Fayette	Typic Hapludalf	sil	P3475	FC	0	ND	ND
12	89	Downs	Mollic Hapludalf	sil	P3475	SM	9	ND	ND
13	89	Fayette	Typic Hapludalf	sil	ML616A	FC	0	4	3.2
14	89	Downs	Mollic Hapludalf	sil	P3475	SM	0	ND	ND
15	89	Fayette	Typic Hapludalf	sil	P3475	SM	0	ND	ND
16	89	Downs	Mollic Hapludalf	sil	P3475	FC	10	ND	ND
17	90	Downs	Mollic Hapludalf	sil	P3475	FC	0	4	ND
18	90	Downs	Mollic Hapludalf	sil	P3751	SC	10	3	ND
21	90	Readlyn	Aquic Hapludoll	l	N6330	FC	0	4	ND
22	90	Ostrander	Typic Hapludoll	l	P3751	FC	0	4	ND
23	91	Readlyn	Aquic Hapludoll	l	P3615	FC	5	3	ND
25	91	Kenyon	Typic Hapludoll	l	T5007	SC	0	5	3.4
27	91	Fayette	Typic Hapludalf	sil	D535	FC	0	4	5.1
28	91	Fayette	Typic Hapludalf	sil	P3475	FC	12	4	5.0
29	91	Downs	Mollic Hapludalf	sil	P3417	FC	0	5	3.0
30	91	Dickinson	Typic Hapludoll	fsl	N4545	FC	0	5	ND

a sil=silt loam, l=loam, sl=sandy loam, cl=clay loam, fsl=fine sandy loam
b D=DeKalb, P=Pioneer, M=Moews, T=Trelay, C=Crows, N=Northrup King, L=Land of Lakes, ML=Mallard
c S=spring, F=fall, C=chisel plow, M=moldboard plow, NT=no till
d ND=not determined

and nitrate by either the steam distillation procedure of Keeney and Nelson (1982) or by Lachat flow-injection analysis (Lachat Instruments, Milwaukee, WI; Methods 12-107-06-2-A and 12-107-04-1-B). Information concerning the soils at each of these trials is provided in Table 1 in the first chapter of this thesis.

Cornstalk samples were collected 1 to 3 weeks after physiological maturity (black layer) by cutting the lower stalk 6 and 14 in. above ground level and saving the remaining 8-in. piece. Ten stalks were cut from each plot and dried in a forced-air dryer at 140°F. The dried stalks were ground to pass a 0.5-mm sieve and extracted in 0.025 *M* $Al_2(SO_4)_3$ with a 1:50 tissue to extractant ratio. The filtered extracts had 1 ml of 2 *M* $(NH_4)_2SO_4$ added to each 50 ml of extract to minimize differences in ionic strength. Nitrate determinations of the prepared extracts were performed using an Orion Model 93-07 nitrate specific electrode (Orion Research Inc., Boston MA).

Grain yields were determined by hand-harvesting 25-ft segments of the center two rows of each plot and adjusting to 15.5% moisture content. A trial was determined responsive to fertilization if the quadratic model could significantly ($P < 0.05$) describe the relationship between grain yields and fertilizer N. Three response models as described in Cerrato and Blackmer, 1990 (quadratic, quadratic-response-and plateau (QRP), exponential or Mitscherlich) were used to describe the relationship between grain yield and fertilizer applied at each responsive trial. Predicted economic optimum fertilizer rates were calculated by equating the first derivative of the response equations to a selected fertilizer-to-corn price ratio and solving for X (Heady et al., 1955; National Academy of Sciences, 1961; Nelson et al., 1985).

Relative yields for each treatment are expressed as percentages of the plateau yield from the QRP model within a trial. If the QRP model could not significantly ($P < 0.05$) describe the relationship between grain yield and fertilizer N, then relative yields for each treatment are expressed as percentages of the mean yield of the 50-lb through 300-lb N/acre treatments within a trial. The relationships between relative yields and soil NO^-_3 or NO^-_3 plus NH^+_4 were described by using the linear-response-and-plateau model (LRP). All statistical analyses were performed by using the NLIN procedure (Ihnen and Goodnight, 1985) or the GLM procedure (Spector et al., 1985).

The procedure used to calculate net returns to fertilization at various soil nitrate concentrations and various fertilizer and grain prices involved, 1) calculating net returns to fertilization at trials where mean nitrate concentrations for the control plots were less than or equal to a specified concentration, 2) assuming no N fertilizer application and, therefore, zero net returns at trials where mean nitrate concentrations for the control plots were greater than the specified concentration, 3) averaging the net returns for all trials at the specified soil nitrate concentration.

RESULTS AND DISCUSSION

Grain yields differed greatly among trials (Fig. 1), and moisture availability seemed to be a major factor responsible for these differences. Mean yields were 162 bu/acre for the 18 trials where rainfall was greater than 19 inches during the growing season and 85 bu/acre for the six trials where rainfall was less than 17 inches. Trials 17 to 30 received unusually high rainfall between April 1 and collection of soil samples in late spring (Fig. 1).

Yield responses to N fertilization were statistically significant ($P < 0.05$) at 8 of the 24 trials when evaluated by using the QRP model (Table 2). This frequency of response is less than reported in many previous studies (Gardner and Robertson, 1952; Schmid et al., 1959; Boawn et al., 1963; Shrader et al., 1966; Adams et al., 1970; Shrader, 1973; Higgs et al., 1976; Baldock et al., 1981; Fox and Piekielek, 1983; Voss and Shrader, 1984; Levin et al., 1987; Fox and Piekielek, 1988), but it should be noted that our study includes twice the number of locations reported in the previous studies. The lower frequency of response can be explained in part by the effects of drought in 1988 and by differences in ages of alfalfa. Most previous studies have used 2-year-old alfalfa, but our study focused on practices common in northeastern Iowa and the average age of alfalfa was 4.1 years.

Rates of fertilization identified as being economically optimal by the QRP model varied considerably with assumed prices of fertilizer and grain. Data in table 2 show that rates often varied by a factor of two with variations in prices that a producer is likely to experience. The

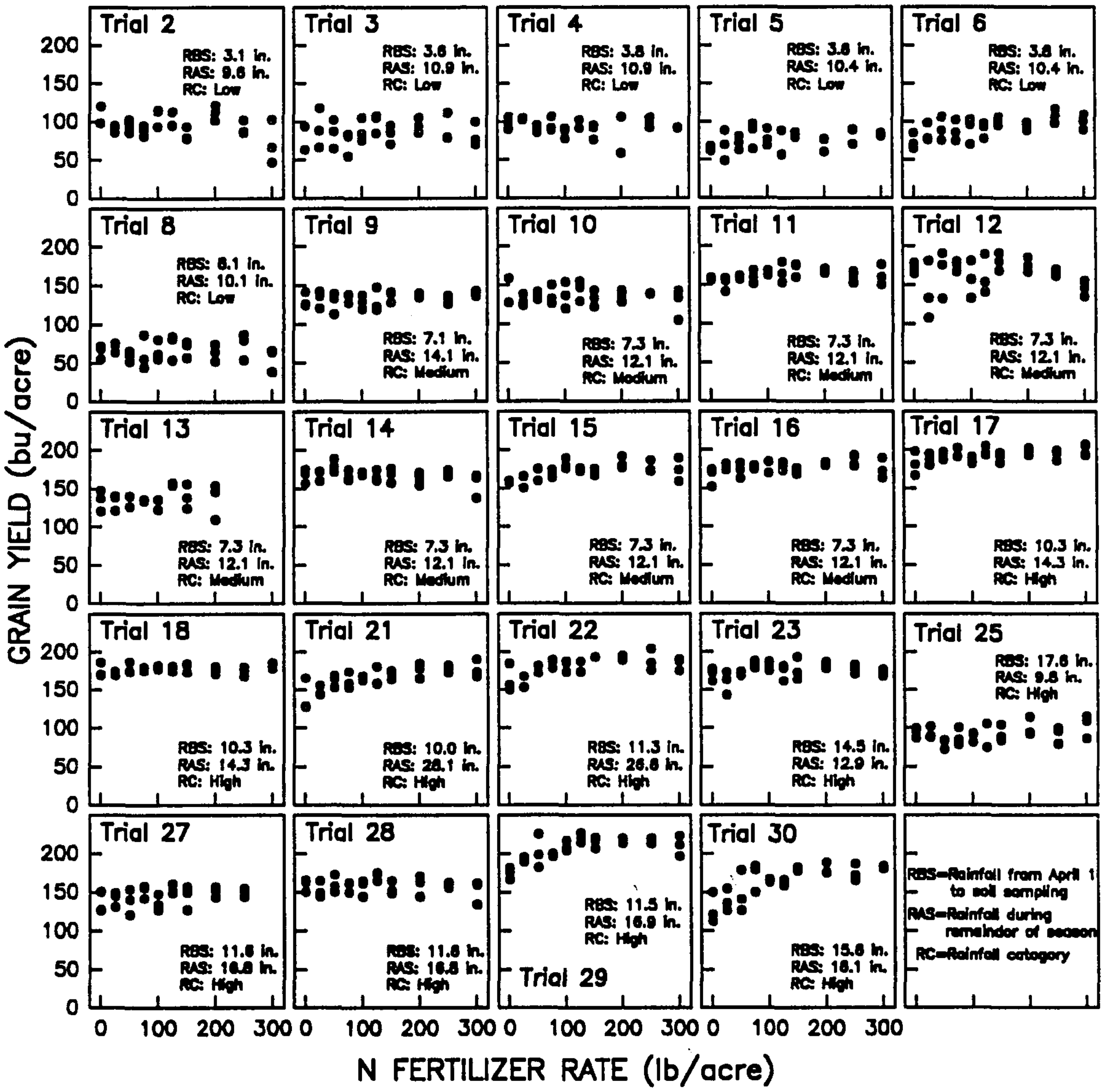

Figure 1. Relationships between grain yields and fertilizer N applied at each trial.

Table 2. Economic optimum N fertilizer rates at N responsive trials as calculated by using three models at two fertilizer and grain prices.

	Economic optimum N rate at four price ratios[a]											
	By QRP model				By Quadratic model				By Mitscherlich model			
Trial	$2.50 / $0.10	$2.00 / $0.10	$2.50 / $0.20	$2.00 / $0.20	$2.50 / $0.10	$2.00 / $0.10	$2.50 / $0.20	$2.00 / $0.20	$2.50 / $0.10	$2.00 / $0.10	$2.50 / $0.20	$2.00 / $0.20
	lb N/acre											
6	224	206	152	116	223	205	152	117	223	194	131	101
11	125	112	75	51	136	125	90	66	104	89	56	40
15	114	110	97	88	162	153	124	105	128	115	88	75
16	NS[b]	NS	NS	NS	137	117	60	22	89	78	56	45
17	70	67	60	54	142	110	14	0	95	83	59	47
21	208	199	174	158	216	207	179	161	216	196	152	131
22	147	141	126	116	173	166	146	133	152	139	110	96
23	NS	NS	NS	NS	134	124	92	72	NS	NS	NS	NS
29	139	136	127	121	179	174	160	150	154	142	118	107
30	179	175	164	156	211	206	190	179	219	203	167	150
Mean[c]	150	143	122	107	171	159	121	100	153	138	104	88
Mean[d]	50	48	41	36	71	66	50	42	57	52	39	33

a grain prices of $2.00 and $2.50/bu; fertilizer N costs of $0.10 and $0.20/lb; application costs of $2.50/acre for $0.20/lb N (assumes liquid N application) and $5.50/acre for $0.10/lb N (assumes anhydrous ammonia application).

b model not significant at $P < 0.05$.

c mean optimum N rate for responsive trials.

d mean optimum N rate for all trials; assumes optimal rate is zero for non-responsive trials.

prices for fertilizer, for example, represent the usual difference in price of the two most commonly used fertilizer materials (anhydrous ammonia and liquid N). If it is assumed that these forms are equally effective, then the data presented in Table 2 reveal that optimal rates of fertilization vary greatly with the fertilizer material used.

The task of identifying optimal rates of fertilization is further complicated by disagreement among commonly used models. The magnitude of this problem is illustrated in Table 2, which shows economic rates as identified by various models. This problem was reported by Cerrato and Blackmer (1990). The models not only disagreed when used to identify optimal rates within responsive trials, they also disagreed concerning the number of trials where responses occurred. The quadratic model, which has been the most widely used model, indicated that substantial amounts of fertilizer N were needed at two trials where the QRP model indicated that responses did not occur.

The wide variety of economic optimum rates of fertilization shown in Table 2 illustrate serious problems encountered when making fertilizer recommendations for second-year corn after alfalfa. One problem is that, even within responsive trials, disagreement among models and uncertainty in prices of grain and fertilizer make it difficult to defend any specific recommendation. Another problem relates to how recommendations should be adjusted to reflect the abundance of trials that did not respond to N fertilizer. We are aware of no published discussions of methods by which defensible fertilizer recommendations could be derived from data in Figure 1 and Table 2.

We reasoned that the rate of fertilization that maximized net returns to fertilization across the 24 trials could be defended as a rational recommendation for conditions represented by the trials. Calculations presented in Fig. 2A show that all rates of fertilization resulted in losses at the least-favorable prices considered. If it is considered that the small blip in the curve at 125 lb N/acre is experimental noise caused by a small sample, then the data presented in Fig. 2A suggest that net returns to fertilization were little influenced by rate of fertilization between 50 and 200 lb N/acre at the prices most favorable for producers. Even at the most favorable prices for the producer, net returns to fertilization averaged less than $10/acre.

Analyses presented in Figs. 2B and 2C show how positive net returns at the responsive trials were offset by negative returns at the non-responsive trials. These observations suggest that the profitability of N fertilization could be substantially improved if responsive and non-responsive trials could be distinguished before fertilizers were applied. Several studies (Magdoff et al., 1984, 1990; Fox et al., 1989; Blackmer et al., 1989; Binford et al., 1992a; Meisinger et al., 1992) have shown that soil tests based on concentrations of soil nitrate in late spring may provide such a distinction, but no studies have evaluated this soil test on second-year corn after alfalfa.

Observed relationships between concentrations of soil nitrate and relative yields (Fig. 3) suggest that the late-spring soil test has great potential for use in second-year corn after alfalfa. The critical concentration of soil nitrate, however, is 14 ppm, which is lower than

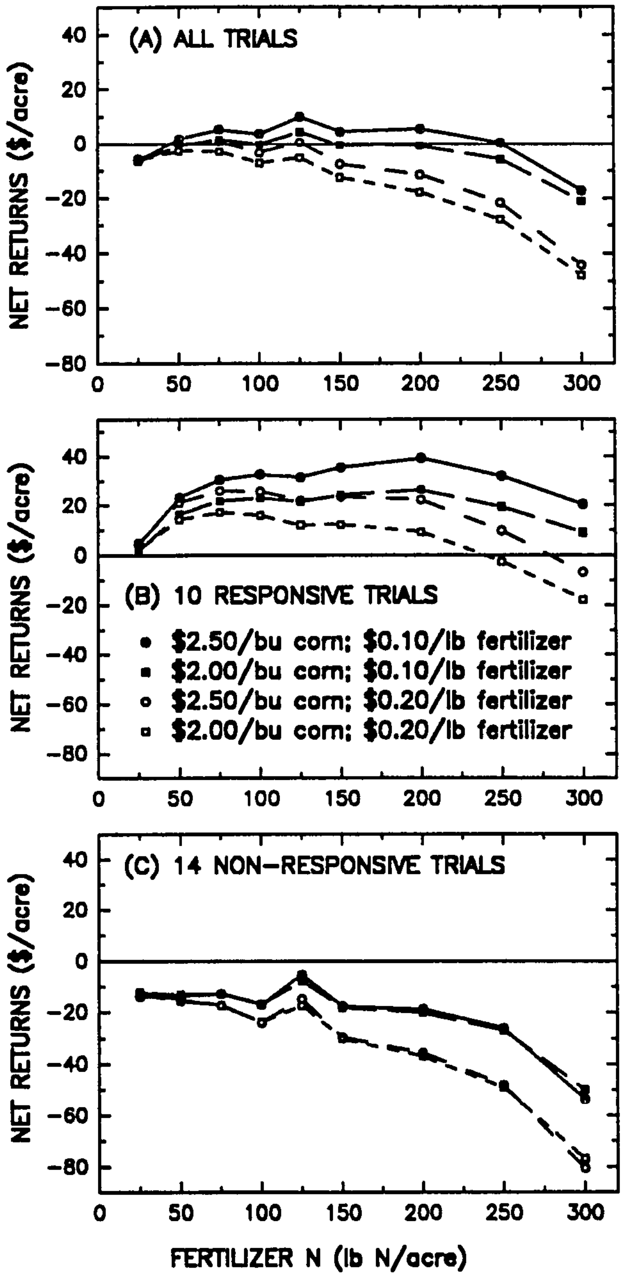

Figure 2. Relationships between net returns to fertilization and fertilizer N applied at two corn prices ($2.00/bu and $2.50/bu) and two fertilizer prices ($0.10/lb and $0.20/lb).

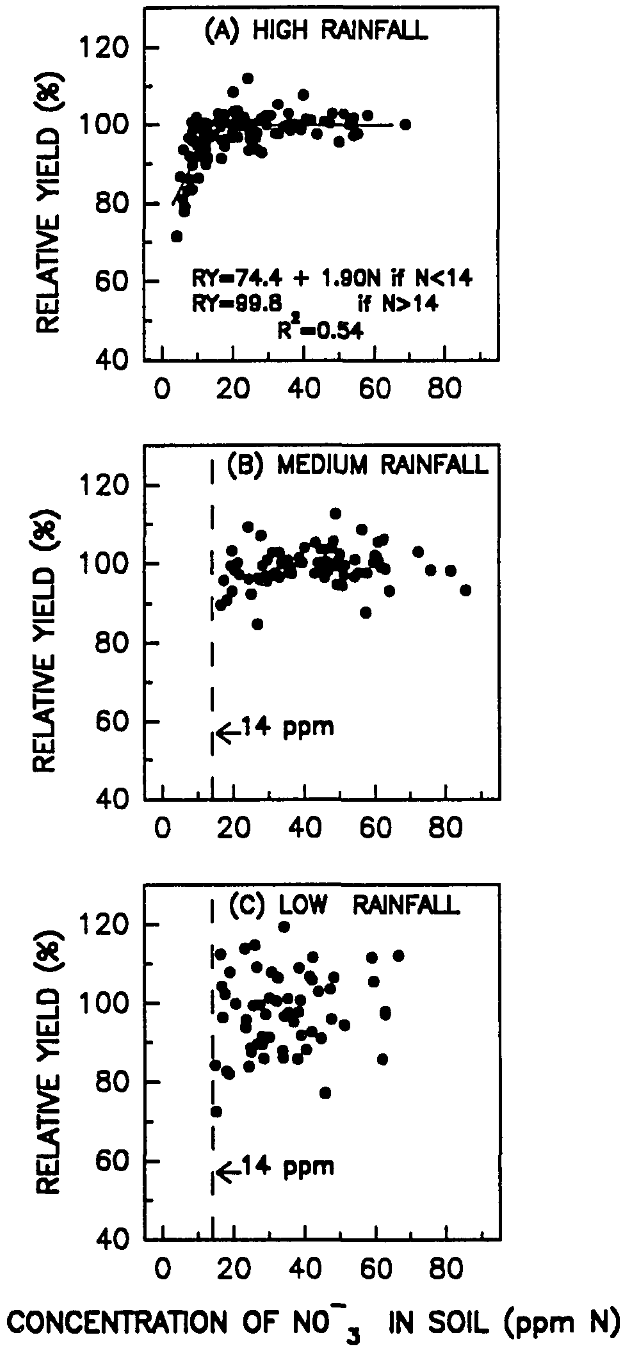

Figure 3. Relationships between relative yields of corn and concentrations of NO^-_3 in the surface 12-in. layer of soil.

the 20-26 ppm reported for corn after corn or corn after soybean. The lower critical concentration for second year corn after alfalfa could be explained by its greater potential for mineralization of N; this explanation is consistent with the low frequency of yield response to N in this study. As illustrated in Figure 3, the critical value for soil nitrate was determined by using observations from only the high-rainfall trials (greater than 10 inches between April 1 and soil sampling) because concentrations less than 14 ppm were not observed at trials having lower rainfall.

A critical concentration of 10 ppm was calculated for a soil test based on the surface 2-foot layer of soil (Fig. 4). The deeper sampling increased the R^2 for the relationship by 9%, which is comparable to the 4% increase reported by Binford et al. (1992a). The added cost to obtain a deeper sample on many Iowa soils may offset the benefit from the improved reliability of the test. Including exchangeable ammonium in the soil test caused a slight decrease in the R^2 for the relationship between soil nitrate and relative yields (data not shown). This finding is similar to observations for corn after corn, corn after soybean, and first-year corn after alfalfa in Iowa (Blackmer et al., 1989; Binford et al., 1992a; Part I of this dissertation).

Estimated net returns to fertilization that is guided by the late-spring soil test (1-ft depth) are shown in Figures 5 and 6. These net returns are estimated by assuming that the effects of N fertilizer applied at time of sidedressing would be the same as the effects of fertilizer applied before planting. We consider this to be a reasonable

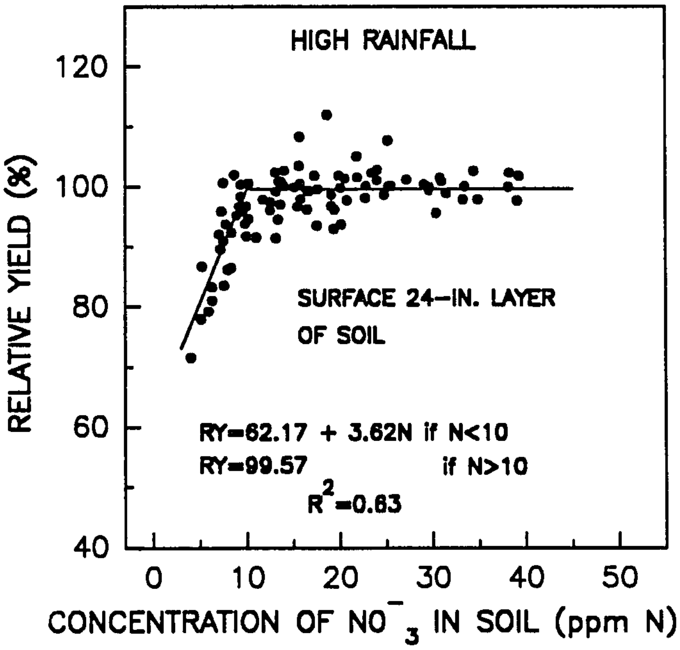

Figure 4. Relationships between relative yields of corn and concentrations of NO^-_3 in the surface 24-in. layer of soil at trials receiving greater than 10 in. of rainfall between April 1 and soil sampling.

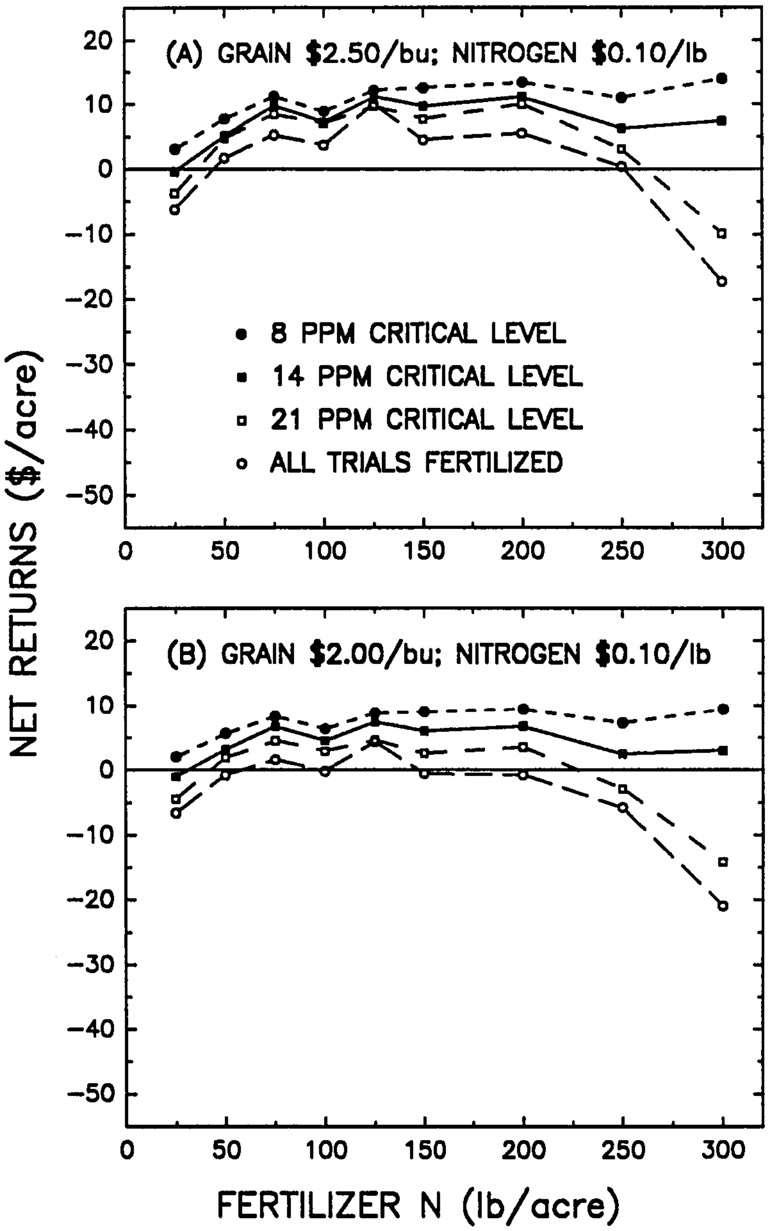

Figure 5. Estimated net returns to fertilization at various rates when the late-spring soil test is used to avoid fertilizing trials testing above selected critical levels. Nitrogen cost of $0.10/lb and grain prices of $2.00 and $2.50/bushel.

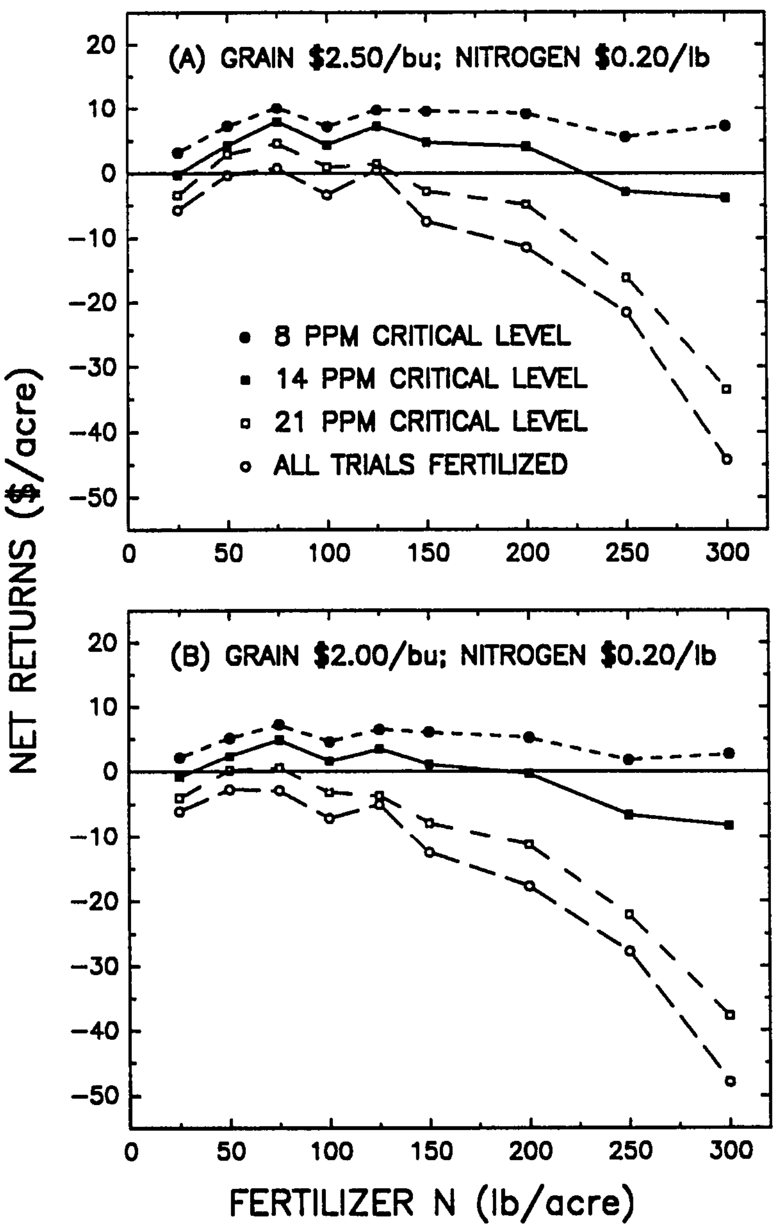

Figure 6. Estimated net returns to fertilization at various rates when the late-spring soil test is used to avoid fertilizing trials testing above selected critical levels. Nitrogen cost of $0.20/lb and grain prices of $2.00 and $2.50/bushel.

assumption because extreme early season deficiencies are not likely to be a problem in second-year corn after alfalfa and because spring-applied N and fall-applied N usually produce similar yields in the western half of the Corn Belt (Bundy et al., 1992; Stevenson and Baldwin, 1969).

Analyses presented in Figures 5 and 6 reveal that, within each price scenario considered, mean net returns to fertilization for the 24 trials was influenced more by use of the soil test than by selection of an N rate within a fairly wide range of N rates. Appropriate use of the soil test transformed negative returns to positive returns at the least favorable price scenario (Fig. 6B), and it increased net returns at the more favorable price scenarios. Net returns to fertilizer were maximized by using a critical level of 8 ppm, which means that fertilizer was not considered to be applied if plots tested higher than 8 ppm.

The rate that maximized net returns to fertilization that was guided by the soil test was 75 lb/acre at the two least favorable price scenarios (Figs. 6a and 6b). This rate also maximized or nearly maximized net returns at the more favorable price scenarios. A defensible recommendation for conditions represented by this study, therefore, would be apply no N before planting, use the late-spring soil test, apply 75 lb N/acre to fields testing 8 ppm or less, and apply no fertilizer to soils testing greater than 8 ppm.

This recommendation would be most defensible if it were coupled with a recommendation to use the end-of-season cornstalk test. Data in Figure 7 shows that nitrate concentrations in the lower stalk were reliable indicators of N status. The ability of the cornstalk test to

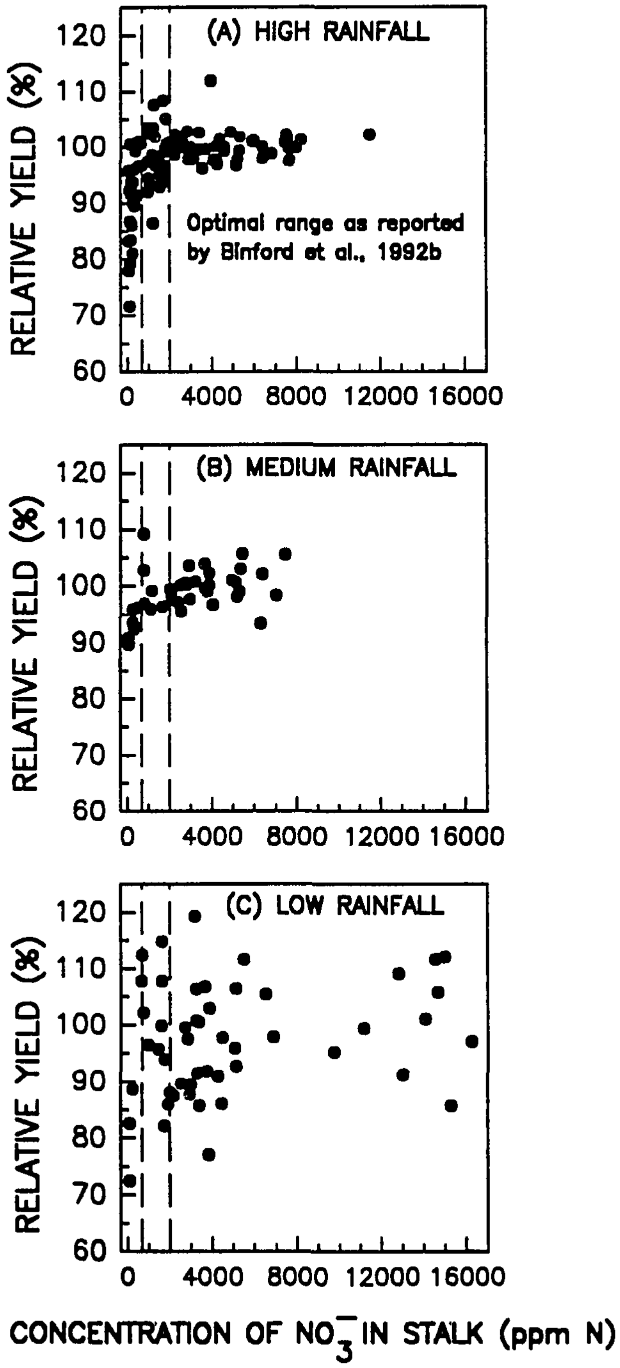

Figure 7. Relationships between relative yields of corn and concentrations of NO^-_3 in the lower cornstalk at one to three weeks after physiological maturity.

detect both deficient and excess applications of N provides a convenient method for verifying the appropriatness of N rates recommended by use of the soil test. Use of the cornstalk test to verify soil test N rates for several years should increase producers' confidence in the recommendations and fine-tune them for their fields.

For fertilization rates between 50 and 150 lb N/acre use of the soil test increased net returns to fertilization by $5.89/acre for the least favorable price scenario and $10.51/acre for the most favorable price scenario. Without use of the soil test net returns to fertilization averaged only $5.01/acre for the best price scenario. These observations suggest that use of a soil test has greater potential for increasing profitability than does any recommendation involving a single rate of fertilization applied to second-year corn after alfalfa. Current N recommendations for second-year corn, which do not use a soil test to guide fertilization, would have resulted in negative returns for all price scenarios except the most favorable (Figs. 5 and 6); a recommendation of 145 lbs N/acre would be attained by using a yield goal of 146 bu/acre (the average yield of the fertilized plots), an efficiency factor of 1.2 lbs/bu, and a credit of 30 lbs N/acre for the alfalfa (Killorn, 1989; Illinois Coop. Ext. Serv., 1991). This demonstrates how use of recommendations based on soil tests can increase profitability of corn production in Iowa. Because use of the soil test would result in application of either 0 or 75 lbs N/acre, which is 70 to 145 lbs/acre below the average recommended rates of fertilization, use of recommendations based on a soil test would also reduce environmental problems associated with fertilizer N.

Data showing that use of a critical value of 8 ppm for the late-spring soil test maximized net returns to fertilization (Figs. 5 and 6) seems to contradict the critical concentration of 14 ppm shown in Figure 3. This apparent contradiction can be explained by recognizing that maximizing yields was the criterion for selecting the critical level of 14 ppm, but maximizing net returns to fertilization was the criterion for selecting the critical level of 8 ppm. Although Figure 3 illustrates the accepted method for establishing critical levels, the method used in Figure 6 is more defensible because it reflects cost of fertilization. Net returns to fertilization has been successfully used to establish critical concentrations for tissue tests (Binford et al., 1992b) and to evaluate the efficacy of alternative critical concentrations for soil tests for P and K in corn (Mallarino and Blackmer, 1992).

CONCLUSIONS

Data from 24 response trials revealed that soil testing for nitrate in late spring has great potential for improving the profitability of N fertilization in second-year corn after alfalfa. Because many trials did not respond to fertilization, the profitability was more determined by use of the soil test than by selection of fertilizer rates within ranges normally used. Analyses presented show that customary methods of making fertilizer recommendations would not have shown the value of the soil test and would have resulted in negative returns to fertilization for most fertilizer and grain prices crop producers have experienced in the past decade.

LITERATURE CITED

Adams, W.E., H.D. Morris, and R.N. Dawson. 1970. Effect of cropping system and nitrogen levels on corn (*Zea mays*) yields in the southern piedmont region. Agron. J. 62:655-659.

Baldock, J.O., R.L. Higgs, W.H. Paulson, J.A. Jackobs, and W.D. Shrader. 1981. Legume and mineral N effects on crop yields in several crop sequences in the upper Mississippi valley. Agron. J. 73:885-890.

Binford, G.D., A.M. Blackmer, and N.M. El-Hout. 1990. Tissue test for excess nitrogen during corn production. Agron. J. 82:124-129.

Binford, G.D., A.M. Blackmer, and M.E. Cerrato. 1992a. Relationships between corn yields and soil nitrate in late spring. Agron. J. 84:53-59.

Binford, G.D., A.M. Blackmer, and B.G. Meese. 1992b. Optimal concentrations of nitrate in cornstalks at maturity. Agron. J. 84:881-887.

Blackmer, A.M., D. Pottker, M.E. Cerrato, and J. Webb. 1989. Correlations between soil nitrate concentrations in late spring and corn yields in Iowa. J. Prod. Agric. 2:103-109.

Boawn, L.C., J.L. Nelson, and C.L. Crawford. 1963. Residual nitrogen from NH_4NO_3 fertilizer and from alfalfa plowed under. Agron. J. 55:231-235.

Bundy, L.G., T.W. Andraski, and T.C. Daniel. 1992. Placement and timing of nitrogen fertilizers for conventional and conservation tillage corn production. J. Prod. Agric. 5:214-221.

Cerrato, M.E., and A.M. Blackmer. 1990. Comparison of models for describing corn yield response to nitrogen fertilizer. Agron. J. 82:138-143.

Fox, R.H., and W.P. Piekielek. 1983. Response of corn to nitrogen fertilizer and the prediction of soil nitrogen availability with chemical tests in Pennsylvania. Agric. Exp. Sta. Bull. 843. The Pennsylvania State Univ., Univ. Park, PA.

Fox, R.H., and W.P. Piekielek. 1988. Fertilizer N equivalence of alfalfa, birdsfoot trefoil, and red clover for succeeding corn crops. J. Prod. Agric. 1:313-317.

Fox, R.H., G.W. Roth, K.V. Iverson, and W.P. Piekielek. 1989. Soil and tissue nitrate tests compared for predicting soil nitrogen availability to corn. Agron. J. 81:971-974.

Gardner, R., and D.W. Robertson. 1952. The effect of alfalfa on the yields of non-leguminous crops in a rotation. p. 224-228. *In* Proc. Am. Soc. Sugar Beet Techn., Seventh general meeting, Feb. 5-8, 1952, Salt Lake City, Utah.

Heady, E.O., J.T. Pesek,and W.G. Brown. 1955. Crop response surfaces and economic optima in fertilizer use. Iowa Exp. Stn. Res. Bull. 424.

Higgs, R.L., W.H. Paulson, J.W. Pendelton, A.E. Peterson, J.A. Jackobs, and W.D. Shrader. 1976. Crop rotations and nitrogen: crop sequence comparisons on soils of the driftless area of southwestern Wisconsin 1967-1974. Research Bull. R2761. College of Agric. and Life Sci., Univ. of Wisconsin, Madison, WI.

Ihnen, L.A., and J.H. Goodnight. 1985. The NLIN procedure. p. 575-606. *In* SAS user's guide: Statistics, 5th ed. SAS Institute Inc., Cary, NC.

Illinois Coop. Ext. Serv. 1991. Illinois agronomy handbook, 1991-1992. Coop. Ext. Serv. Circ. 1311. Univ. of Illinois, Urbana, IL.

Keeney, D.R., and D.W. Nelson. 1982. Nitrogen-Inorganic forms. p. 643-698. *In* A. L. Page et al., (ed.) Methods of soil analysis. Part 2. 2nd ed. Agron. Monogr. ASA and SSSA, Madison, WI.

Killorn, R. 1989. Interpretation of soil test results. Iowa State Univ. Ext. Pamph. Pm-1310. Coop Ext Serv., Ames, IA.

Levin, A., D.B. Beegle, and R.H. Fox. 1987. Effect of tillage on residual nitrogen availability from alfalfa to succeeding corn crops. Agron. J. 79:34-38.

Magdoff, F.R., D. Ross, and J. Amadon. 1984. A soil test for nitrogen availability to corn. Soil Sci. Soc. Am. J. 48:1301-1304.

Magdoff, F.R., W.E. Jokela, R.H. Fox, and G.F. Griffin. 1990. A soil test for nitrogen availability in the Northeastern United States. Commun. Soil Sci. Plant Anal. 21:1103-1115.

Mallarino, A.P., and A.M. Blackmer. 1992. Comparison of methods for determining critical concentrations of soil test phosphorus for corn. Agron. J. 84:850-856.

Meisinger, J.J., V.A. Bandel, J.S. Angle, B.E. O'Keefe, and C.M. Reynolds. 1992. Presidedress soil nitrate test evaluation in Maryland. Soil Sci. Soc. Am. J. 56:1527-1532.

National Academy of Sciences-National Research Council, committee on economics of fertilizer use of the agricultural board, 1961. Statistical methods of research in economic and agronomic aspects of fertilizer response and use. NAS-NRC Pub. 918, National Academy of Sciences-National Research Council, Washington, D.C.

Nelson, L.A., R.D. Voss, and J.T. Pesek. 1985. Agronomic and statistical evaluation of fertilizer response. p. 53-90. *In* O.P. Engelstad (ed.), Fertilizer technology and use, 3rd ed., American Society of Agronomy, Madison WI.

Schmid, A.R., A.C. Caldwell, and R.A. Briggs. 1959. Effect of various meadow crops, soybeans, and grain on the crops which follow. Agron. J. 51:160-162.

Shrader, W.D., W.A. Fuller, and F.B. Cady. 1966. Estimation of a common nitrogen response function for corn (*Zea mays*) in different crop rotations. Agron. J. 58:397-401.

Shrader, W.D. 1973. Legumes-how much N do they provide? Iowa State Univ. Ext. Pamph. EC-810. Coop Ext Serv., Ames, IA.

Spector, P.C., J.H. Goodnight, J.P. Sall, and W.S. Sarle. 1985. The GLM procedure. p. 433-506. *In* SAS user's guide: Statistics, 5th ed. SAS Institute Inc., Cary, NC.

Stevenson, C.K., and C.S. Baldwin. 1969. Effect of time and method of nitrogen application and source of nitrogen on the yield and nitrogen content of corn (*Zea mays* L.). Agron. J. 61:381-384.

Voss, R.D., and W.D. Shrader. 1984. Crop rotations: Effect on yields and response to nitrogen. Iowa State Univ. Ext. Serv. Pamph. Pm-905. Coop. Ext. Serv., Ames, IA.

GENERAL SUMMARY

The studies for this dissertation were divided into two parts. The first part consists of nitrogen response studies at 29 locations in first-year corn after alfalfa from 1987 to 1990. The second part consists of nitrogen response studies at 24 locations in second-year corn after alfalfa from 1988 to 1991. The primary objectives of these studies were (i) to determine optimal rates of N fertilization for first- and second-year corn after alfalfa without the using the concept of fertilizer N equivalence and (ii) to evaluate a soil test based on concentrations of soil nitrate in late-spring for its ability to evaluate N status in first-and-second-year corn after alfalfa. The end-of-season cornstalk test was used to help achieve these objectives and was evaluated as a tool that could be used by producers to refine fertilizer N recommendations.

The results in paper I indicate that little or no response to N fertilization should be expected in first-year corn after alfalfa. Statistical analysis indicated no significant response to fertilization at 23 of the 29 trials. At the six responsive trials, a yield increase was observed at only the first increment of N (25 lbs/acre). Transforming the yield response data to net returns to fertilization showed that applications of 0 and 25 lbs N/acre were the most profitable. These rates were lower than those indicated by current recommendations based on yield goals, and they were substantially less than the N rates producers are currently applying. It was shown that N recommendations for this crop would be more defensible if the concept of fertilizer equivalence were not used. The late-spring soil test and the end-of-season cornstalk test were shown to be useful only in situations where application of N rates greater than 25 lbs/acre were applied.

The results in paper II indicate that the late-spring soil test was a reliable predictor of N status in second-year corn after alfalfa. The prediction of N status in this crop was especially important because 16 of the 24 trials did not response to fertilization, and because the amount of N required at the responsive trials was highly variable. Use of the late-spring soil test to guide fertilization increased net returns to fertilization $5.50/acre when fertilizer and grain prices were favorable for producers and $11.99/acre when prices were unfavorable for producers. Without use of the soil test net returns to fertilization averaged only $5.01/acre for the most favorable price scenario. Analyses presented show that customary methods of making fertilizer recommendations would not have shown the value of the soil test and would have resulted in negative returns to fertilization for most fertilizer and grain prices crop producers have experienced in the past decade.

Overall the results show that use of the late-spring soil test and the end-of-season cornstalk test should help producers increase their profits by reducing costs of fertilization for corn after alfalfa. Additional benefits would include substantial reductions in the environmental costs associated with the use of N fertilizer.

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To Janet McAllister, thanks love - life is a joy when you are around.

APPENDIX

Table 1. Data collected at trial 1 for first year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)		-------------	(ppm N)	----------	
0	1	168.8	19029	34.1	6.4	5.1	3.7
0	2	165.9	20634	15.6	5.3	4.6	2.2
0	3	163.5	18570	20.8	8.8	5.5	5.4
25	1	173.2	19946	32.2	6.3	4.5	4.4
25	2	155.4	18341	27.0	4.8	4.3	3.0
25	3	156.6	18341	26.7	9.5	4.7	4.6
50	1	170.4	19029	29.2	6.1	5.0	6.2
50	2	172.8	20175	27.9	9.1	4.6	2.7
50	3	167.1	19258	33.0	4.7	6.5	4.5
75	1	179.1	20863	28.1	6.1	4.9	3.5
75	2	167.2	19487	28.1	14.0	5.8	3.9
75	3	155.7	17653	38.6	5.0	9.7	4.0
100	1	173.4	20175	27.4	16.7	11.3	7.8
100	2	153.6	17653	27.2	5.9	7.2	4.3
100	3	157.8	20634	30.0	7.2	8.6	4.8
150	1	147.3	15590	58.6	12.0	15.2	5.1
150	2	180.2	21092	32.1	6.8	7.6	4.0
150	3	118.8	18800	44.8	12.9	9.7	5.9
200	1	176.9	20175	45.0	24.4	24.0	11.0
200	2	153.2	16736	37.4	24.2	11.6	11.4
200	3	154.0	18341	39.5	7.6	13.2	7.7

Table 2. Data collected at trial 3 for first year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	-----------	(ppm N)	-----------	
0	1	161.8	19717	47.1	22.6	7.1	2.7
0	2	180.4	22238	30.9	14.9	5.6	4.7
0	3	183.8	22009	27.4	8.0	4.1	3.4
25	1	185.9	23453	35.2	9.5	5.3	2.7
25	2	189.6	22468	39.4	15.7	4.5	4.1
25	3	180.6	20863	34.4	8.9	4.3	3.3
50	1	171.9	21321	45.5	19.6	5.0	4.4
50	2	166.8	21092	44.8	8.1	5.6	2.7
50	3	165.7	19717	37.4	7.9	4.3	3.6
75	1	171.5	20634	60.0	19.1	5.1	5.7
75	2	183.9	22009	43.5	13.7	4.2	4.1
75	3	192.7	22468	52.2	12.5	5.9	3.5
100	1	183.6	21780	43.7	12.3	8.1	6.5
100	2	190.3	22238	49.8	12.9	8.3	4.5
100	3	173.1	22468	56.6	12.2	4.6	3.8
150	1	186.3	22009	47.8	30.6	7.1	7.1
150	2	181.2	21321	67.5	25.5	7.4	6.9
150	3	179.7	20634	59.9	10.6	5.7	5.1
200	1	151.0	16966	79.2	14.2	7.2	7.2
200	2	189.3	22697	59.8	9.8	11.5	4.9
200	3	169.0	22697	73.4	38.4	17.7	20.2

Table 3. Data collected at trial 3 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	142.4	21780	27.4	11.4	3.2	2.0	4529
0	2	117.2	15682	27.2	10.0	3.6	6.3	4348
0	3	123.5	20328	22.1	9.7	3.1	2.7	4351
25	1	159.3	23813	27.4	11.1	5.4	3.0	4697
25	2	155.4	23522	26.2	8.4	4.5	2.9	3983
25	3	146.7	24394	30.0	10.0	7.0	5.2	3533
50	1	155.2	21780	26.3	11.7	2.8	2.7	4709
50	2	146.5	24103	34.6	9.9	7.0	3.2	5312
50	3	149.5	21780	29.5	11.4	7.9	4.1	5311
75	1	126.8	18585	44.5	16.1	5.9	5.3	4697
75	2	142.7	22070	30.4	16.8	5.8	3.4	4709
75	3	136.2	18585	38.8	12.0	3.4	2.3	4514
100	1	151.6	22651	43.6	18.4	4.6	3.9	5547
100	2	150.3	20328	41.0	13.9	7.0	5.9	4700
100	3	128.1	20909	49.7	18.0	7.0	6.1	6004
150	1	156.6	26136	57.8	26.0	9.1	9.2	6795
150	2	130.8	20038	54.8	26.7	7.2	7.2	6013
150	3	138.8	22942	60.3	25.6	8.0	14.0	4716
200	1	130.9	20909	51.1	26.5	14.8	11.0	4698
200	2	154.8	24974	56.7	17.3	10.9	5.5	6787
200	3	149.4	23522	67.8	14.4	7.9	6.1	6524

Table 4. Data collected at trial 4 for first year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	-------	-------	(ppm N)	-------	-------
0	1	155.3	26136	36.6	12.8	7.1	2.9	9246
0	2	151.8	26426	37.8	8.6	6.4	3.7	6959
0	3	145.8	21780	30.1	10.7	9.0	3.4	5224
25	1	147.6	24684	39.8	12.6	8.0	4.6	8177
25	2	140.7	24394	26.2	6.5	4.3	6.7	6521
25	3	148.6	22942	40.0	14.2	5.7	7.7	9073
50	1	150.7	22942	38.0	8.6	5.3	3.2	7707
50	2	141.0	24103	46.7	13.0	5.7	3.7	10216
50	3	167.2	28169	58.1	15.2	8.4	4.8	9084
75	1	147.7	26426	38.5	15.3	4.8	3.7	9440
75	2	153.9	25265	35.6	11.2	4.4	4.3	9469
75	3	161.0	27879	48.1	12.1	4.7	3.5	8210
100	1	147.8	22070	43.1	11.0	4.6	3.7	8745
100	2	154.0	25846	52.1	15.8	6.9	4.1	6974
100	3	152.0	24394	53.8	12.8	6.1	4.4	10691
150	1	152.5	24974	49.5	16.3	12.4	5.9	8893
150	2	166.2	27007	54.8	14.6	5.2	6.0	8203
150	3	155.7	23522	48.4	13.3	5.2	3.3	10481
200	1	138.1	22651	60.8	18.3	17.1	5.0	9463
200	2	144.7	23813	62.5	14.7	20.0	6.7	9649
200	3	146.0	24394	71.0	22.0	32.8	7.4	10089

Table 5. Data collected at trial 3 for first year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	---------------		(ppm N)		--------------
0	1	182.6	23570	24.3	9.1	6.3	3.0	2623
0	2	177.8	21780	28.3	10.7	3.5	2.6	2127
0	3	199.4	26136	31.4	13.0	5.1	2.9	4521
25	1	192.9	24394	37.3	8.1	3.7	2.9	3313
25	2	198.9	24103	36.7	12.0	3.7	3.3	4422
25	3	201.9	25555	35.4	9.4	4.8	2.8	5252
50	1	171.9	25555	43.8	16.2	5.8	4.7	5256
50	2	185.6	25555	33.4	9.0	3.9	2.7	4612
50	3	187.5	24103	36.4	10.3	4.9	2.5	3930
75	1	197.2	24974	34.1	11.9	4.6	3.4	4257
75	2	189.5	24684	48.7	15.0	7.3	4.0	5936
75	3	186.7	22942	48.2	10.0	7.4	3.7	4829
100	1	194.2	24684	46.0	17.9	6.9	4.2	5945
100	2	187.8	24974	42.6	8.8	4.9	3.6	5682
100	3	185.9	23232	44.5	15.1	4.8	5.5	7636
150	1	187.8	21489	48.5	18.1	8.9	7.3	5691
150	2	186.2	23232	56.4	11.3	9.5	5.0	6209
150	3	194.7	24394	54.8	10.3	9.6	4.6	6753
200	1	196.4	25265	62.2	13.0	9.8	5.4	7350
200	2	193.9	26426	68.4	11.9	19.5	7.8	8318
200	3	175.3	19747	62.9	10.7	15.6	5.9	6760

Table 6. Data collected at trial 6 for first year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	173.7	23522	17.2	8.0	3.7	1.3	118
0	2	180.4	24684	20.6	5.9	3.2	0.9	188
0	3	177.8	25265	16.7	7.7	3.6	0.9	100
25	1	184.4	25555	25.5	8.0	2.9	1.6	217
25	2	170.0	21199	26.2	9.1	4.3	1.3	316
25	3	187.8	24684	22.0	6.8	3.9	1.3	330
50	1	188.3	25265	27.8	8.4	3.0	1.1	619
50	2	198.6	24394	27.6	10.9	4.6	2.7	1993
50	3	179.9	24684	22.9	8.6	3.5	2.2	1115
75	1	194.0	24974	35.9	15.5	5.3	3.4	1870
75	2	199.5	26717	37.1	10.7	5.0	2.3	2684
75	3	190.7	23813	36.3	12.4	7.1	3.9	2106
100	1	199.8	26136	31.0	13.2	5.5	6.0	3051
100	2	196.5	25555	29.2	8.6	5.2	1.5	4371
100	3	166.6	23813	30.7	9.7	4.7	2.8	3163
150	1	213.9	26426	42.3	9.5	9.6	4.4	6562
150	2	180.1	23232	33.6	9.1	7.4	2.7	5590
150	3	188.6	24684	39.3	11.0	8.1	3.4	4210
200	1	188.4	26717	37.3	7.9	7.3	2.3	7412
200	2	188.6	25265	44.9	17.0	15.2	16.4	6835
200	3	208.4	27879	42.3	14.1	12.5	11.0	6032

Table 7. Data collected at trial 7 for first year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	-------	-------	(ppm N)	-------	-------
0	1	162.7	27879	33.4	12.4	5.8	3.5	2813
0	2	177.4	25555	27.0	18.1	4.6	3.4	3038
0	3	172.0	26717	31.2	15.4	6.7	3.9	3431
25	1	169.8	27588	31.5	15.0	6.7	6.5	3156
25	2	164.9	24394	41.4	15.5	6.5	3.1	3290
25	3	171.5	25846	37.8	11.3	5.2	2.9	2799
50	1	184.1	29330	41.7	17.6	5.3	3.3	2691
50	2	165.6	26717	32.6	14.3	6.5	3.1	2587
50	3	166.1	26136	45.9	19.3	4.8	5.5	3161
75	1	174.3	28750	36.4	14.6	5.5	9.5	2805
75	2	177.6	27588	44.4	11.5	5.1	4.5	3157
75	3	164.6	29911	72.5	33.9	5.2	17.5	3433
100	1	174.4	29330	55.4	14.0	6.1	4.3	2553
100	2	182.5	27298	52.5	24.8	7.0	7.9	3133
100	3	172.6	29040	42.0	15.7	5.2	5.9	2897
150	1	170.7	28161	58.2	26.6	4.7	5.9	2661
150	2	174.2	28169	57.7	18.7	9.2	7.6	4190
150	3	177.8	27007	53.6	13.8	10.4	5.9	2882
200	1	164.8	26136	67.3	18.1	5.7	6.2	3400
200	2	177.1	27588	63.5	22.1	7.8	10.3	2550
200	3	185.7	27588	67.9	22.6	6.2	5.7	3691

Table 8. Data collected at trial 8 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	--------------		(ppm N)		-------------
0	1	71.1	22651	40.2	12.5	5.1	1.5	7236
0	2	75.3	24045	28.0	19.2	3.5	2.3	10486
0	3	65.4	22651	34.7	11.1	4.3	1.8	8180
25	1	90.7	24045	45.1	26.1	4.9	2.5	8862
25	2	81.0	23697	49.2	13.9	5.2	2.9	8949
25	3	67.0	24045	42.5	12.8	3.5	1.5	10484
50	1	73.7	23000	45.1	16.6	4.3	1.8	7912
50	2	63.0	23697	40.8	27.2	4.5	3.1	11326
50	3	58.1	24394	37.4	12.3	3.1	2.0	8901
75	1	66.3	22651	61.0	42.6	4.5	7.3	11801
75	2	88.7	22303	65.9	17.9	5.8	2.2	10103
75	3	62.2	25091	41.3	14.0	4.4	3.1	8380
100	1	71.9	23348	65.2	20.0	5.6	2.2	11326
100	2	68.4	24045	48.4	15.7	5.3	3.0	11808
100	3	61.0	25439	53.3	16.2	6.4	2.2	11189
150	1	88.1	23000	64.8	26.5	7.2	6.6	10478
150	2	64.1	23348	53.5	17.5	5.6	3.9	8909
150	3	66.1	23348	54.8	29.6	5.5	7.0	10772
200	1	80.8	24394	84.1	23.3	7.0	4.0	11371
200	2	67.9	24394	72.3	18.4	6.3	2.9	10896
200	3	68.5	24742	48.9	25.3	6.8	7.1	10750

Table 9. Data collected at trial 9 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	----------- (ppm N) --------			
0	1	106.3	21257	32.0	5.6	5.9	2.4
0	2	73.0	18818	26.8	6.2	5.3	2.8
0	3	98.2	22651	39.0	6.8	5.2	3.2
25	1	112.9	24742	38.9	5.6	10.9	5.2
25	2	115.4	19515	38.2	4.7	9.1	5.9
25	3	104.4	22651	31.1	11.3	7.2	6.5
50	1	103.8	22303	41.6	9.1	10.6	5.9
50	2	97.9	21606	35.4	5.3	9.2	4.5
50	3	109.1	22651	45.1	18.6	9.7	11.2
75	1	103.2	20909	40.1	8.0	11.5	6.1
75	2	88.7	22651	40.6	19.9	16.7	12.6
75	3	79.3	23000	41.3	12.9	10.1	8.9
100	1	100.0	23697	47.7	11.3	12.5	9.1
100	2	105.7	21257	43.1	14.8	14.3	10.3
100	3	105.3	22303	52.5	5.0	11.9	6.0
150	1	108.7	20909	47.8	16.9	22.3	24.5
150	2	126.6	22303	41.2	2.5	13.6	3.3
150	3	103.6	23697	46.7	7.8	19.0	8.7
200	1	104.1	24394	45.2	23.5	15.2	21.2
200	2	101.7	25091	52.3	8.0	14.1	7.6
200	3	96.3	20560	53.7	9.8	23.3	11.7

Table 10. Data collected at trial 10 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	--------------	--------------	(ppm N)	--------------	--------------
0	1	128.6	22834	11.9	10.8	3.5	3.5	481
0	2	114.3	22009	16.8	5.7	3.4	2.5	809
0	3	90.2	22284	10.8	3.2	4.7	3.2	1487
25	1	132.9	21734	16.9	5.0	5.9	3.9	1445
25	2	109.1	21459	13.9	5.7	3.7	2.2	353
25	3	115.3	20909	17.6	12.0	3.9	2.7	475
50	1	124.3	19533	19.4	6.8	3.8	2.6	2041
50	2	123.8	22834	27.5	5.0	4.2	2.2	1243
50	3	136.4	22284	31.3	7.5	4.2	2.8	907
75	1	122.1	22009	15.9	17.5	6.4	7.0	2574
75	2	124.1	17607	20.1	15.0	5.0	2.8	2156
75	3	130.4	21734	16.8	22.1	4.3	3.9	1480
100	1	100.0	18983	19.0	8.3	5.1	3.4	2314
100	2	117.8	20083	34.5	7.5	4.1	2.4	1910
100	3	126.8	18708	19.7	5.2	3.9	2.5	2119
150	1	122.1	19809	30.4	8.1	4.7	3.5	3037
150	2	127.4	21459	18.3	21.7	3.3	3.1	2261
150	3	129.4	20359	23.6	28.7	4.4	8.1	2089
200	1	137.1	21459	31.6	7.5	7.9	2.8	3263
200	2	112.7	21184	27.1	12.8	7.3	5.3	3869
200	3	119.6	22834	46.1	7.3	5.7	2.6	3030

Table 11. Data collected at trial 11 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	139.2	24103	34.9	16.8	4.6	3.2	2391
0	2	131.8	23813	18.7	13.4	4.7	3.1	597
0	3	125.7	24103	21.4	10.0	4.8	3.0	502
25	1	151.7	23522	29.0	7.6	6.1	4.1	1326
25	2	146.4	20618	28.0	5.4	5.0	3.5	779
25	3	139.3	24394	23.9	7.8	6.5	3.8	886
50	1	152.6	24974	39.6	9.0	6.9	5.1	2118
50	2	130.6	20909	27.4	7.2	6.7	8.0	1130
50	3	138.6	22942	30.0	8.7	5.1	3.9	1364
75	1	141.2	21489	42.1	10.8	6.3	4.9	2150
75	2	146.0	24103	33.8	10.6	5.8	7.0	1925
75	3	140.8	22651	33.0	22.0	6.5	5.5	2552
100	1	139.4	24684	51.4	9.7	8.7	4.3	2853
100	2	139.5	23232	49.5	11.3	8.0	5.0	2787
100	3	137.2	20909	49.3	8.1	9.9	4.3	1968
150	1	143.8	24103	48.4	43.0	8.9	8.5	2640
150	2	145.0	25265	25.4	15.6	5.6	7.6	4391
150	3	127.7	24394	16.4	10.8	5.6	6.2	2758
200	1	131.3	22942	63.0	10.0	9.9	5.4	3773
200	2	129.2	21489	51.5	6.1	13.2	6.5	2512
200	3	142.3	23813	46.0	8.0	7.4	6.3	2264

Table 12. Data collected at trial 12 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	119.1	22303	17.8	3.8	3.9	2.6	96
0	2	131.4	24742	38.8	4.8	4.1	2.6	209
0	3	133.2	23697	35.8	6.2	6.2	3.7	794
25	1	135.9	24394	21.3	6.2	6.0	3.1	418
25	2	117.8	23348	19.9	14.6	3.2	4.5	767
25	3	135.5	24742	29.9	9.7	5.5	4.9	868
50	1	118.6	23000	28.2	18.2	5.3	4.5	830
50	2	128.1	22651	29.9	5.7	9.6	3.0	1018
50	3	122.7	22651	23.7	9.8	4.6	4.5	555
75	1	130.2	23000	27.5	9.5	9.9	5.2	1098
75	2	128.2	23000	36.2	11.7	5.1	5.8	937
75	3	119.5	23697	32.3	6.8	5.8	3.8	402
100	1	114.0	24045	50.3	9.2	5.6	4.1	1591
100	2	119.5	22303	25.0	8.7	4.7	4.9	870
100	3	128.3	23697	21.7	16.0	3.7	8.1	1352
150	1	131.2	21954	38.3	21.4	7.8	5.7	1955
150	2	123.8	20909	41.1	8.3	6.6	5.5	1296
150	3	125.8	21954	40.0	7.7	7.6	4.5	977
200	1	124.9	24045	53.4	23.5	9.0	9.2	1791
200	2	125.6	22303	65.7	11.7	12.6	6.3	1865
200	3	127.2	22651	43.4	7.2	12.0	6.7	1663

Table 13. Data collected at trial 14 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	(ppm N)			
0	1	101.2	17332	25.5	5.2	5.2	4.3
0	2	92.6	14856	24.1	5.7	6.0	3.9
0	3	55.5	11830	35.0	3.9	3.9	2.2
25	1	94.6	15957	26.4	4.6	5.8	3.0
25	2	92.9	13756	24.2	7.1	5.7	2.4
25	3	80.7	13481	31.6	18.2	5.0	5.1
50	1	83.1	12105	30.1	7.8	5.1	4.2
50	2	101.0	14306	24.6	9.6	5.3	4.0
50	3	100.9	15682	38.9	6.0	4.8	3.5
75	1	88.5	14306	35.6	7.8	8.9	6.7
75	2	101.8	14031	34.6	28.6	5.6	4.8
75	3	76.9	13481	37.2	19.9	6.2	9.7
100	1	76.8	14031	43.5	6.0	7.2	3.2
100	2	108.1	14306	37.8	4.0	6.1	3.8
100	3	100.9	14031	36.3	10.1	6.7	4.7
150	1	99.7	12930	45.5	5.9	15.9	3.9
150	2	96.6	14031	36.2	6.0	6.6	4.4
150	3	101.2	14581	39.2	8.3	6.4	7.1
200	1	87.1	11280	46.4	35.0	6.6	11.9
200	2	59.9	12380	52.8	8.7	8.6	5.2
200	3	102.0	15406	46.5	16.1	9.0	13.0

Table 14. Data collected at trial 15 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	-----------	(ppm N)	----------	
0	1	129.8	20909	15.3	6.9	4.1	2.3
0	2	125.0	21184	16.5	7.2	5.8	3.6
0	3	135.8	20359	16.4	5.6	4.4	4.3
25	1	114.3	22009	18.8	7.2	4.6	3.8
25	2	92.9	20359	19.5	6.3	5.5	3.0
25	3	133.2	21734	25.6	12.2	4.4	2.8
50	1	108.1	18983	26.2	8.6	6.0	4.0
50	2	124.8	19533	21.3	7.2	4.6	2.4
50	3	125.4	22284	24.4	23.8	5.6	6.7
75	1	72.7	16507	22.3	11.1	6.7	5.0
75	2	134.8	22834	25.1	12.3	6.6	5.2
75	3	135.7	22834	29.6	17.0	6.5	5.0
100	1	123.6	20634	30.4	11.2	6.1	5.9
100	2	113.2	21184	18.2	20.4	4.2	4.0
100	3	131.5	20909	35.6	8.7	6.4	3.5
150	1	134.9	23110	41.4	27.6	8.0	5.9
150	2	143.5	21184	38.0	21.3	5.5	4.1
150	3	136.7	20359	48.2	27.2	6.1	8.9
200	1	127.3	19809	37.4	12.1	9.0	6.8
200	2	111.6	21459	26.8	8.2	6.9	4.4
200	3	141.3	21734	51.6	15.8	10.1	7.0

Table 15. Data collected at trial 16 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	----------------		(ppm N)		---------------
0	1	96.5	21459	29.5	9.0	4.3	3.7	862
0	2	113.3	20909	21.6	13.9	5.2	4.2	1017
0	3	127.6	23385	32.1	10.1	6.7	3.1	1051
25	1	120.1	22009	38.0	9.5	5.3	3.9	1199
25	2	111.6	23110	35.4	9.4	5.9	3.8	1066
25	3	122.7	23110	37.5	15.0	6.3	4.2	1722
50	1	121.6	22284	43.6	9.0	4.7	3.7	1861
50	2	128.4	23935	37.1	13.8	4.8	4.5	1464
50	3	115.8	24485	40.4	7.3	4.9	4.5	737
75	1	115.2	23385	28.7	24.4	5.5	5.2	2687
75	2	114.4	24485	41.4	18.4	6.2	5.1	2294
75	3	120.3	23110	52.7	10.4	5.1	4.4	1590
100	1	122.7	24210	48.1	31.5	5.3	4.2	3252
100	2	122.6	22284	50.3	9.2	5.9	3.7	1017
100	3	106.7	22560	48.8	13.3	5.9	5.0	1408
150	1	107.8	23385	40.4	9.0	5.6	3.7	924
150	2	122.2	24210	55.0	18.9	7.2	6.3	1607
150	3	124.5	23660	47.7	37.0	6.4	6.7	2304
200	1	118.4	23110	63.6	15.0	12.4	5.8	4025
200	2	121.2	23935	61.5	21.7	6.1	6.3	3573
200	3	134.7	25036	43.7	32.7	5.5	8.8	3042

Table 16. Data collected at trial 17 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	---------- (ppm N)	----------		
0	1	180.6	20560	31.9	10.5	7.7	3.0
0	2	174.2	25439	31.0	8.3	6.6	5.0
0	3	185.2	24045	32.0	5.8	5.2	2.2
25	1	129.9	20909	34.2	9.0	4.0	3.6
25	2	147.0	22651	33.7	7.1	6.4	3.5
25	3	148.7	20212	34.3	6.9	5.0	2.7
50	1	159.1	21606	32.4	8.1	6.0	5.9
50	2	131.3	25091	30.9	7.5	6.9	2.8
50	3	173.3	24742	35.5	7.5	4.5	3.2
75	1	154.9	24045	52.2	9.0	5.3	6.3
75	2	162.2	21606	42.4	5.4	13.7	4.8
75	3	191.0	25439	49.8	8.7	5.7	3.2
100	1	172.7	22303	49.5	8.7	8.8	4.0
100	2	157.6	24045	49.8	14.5	5.7	5.5
100	3	180.8	23000	46.0	7.7	6.5	4.3
150	1	164.7	24394	56.2	14.3	6.1	3.6
150	2	185.5	24742	74.5	14.8	8.5	5.9
150	3	149.4	21257	49.6	8.7	5.3	2.8
200	1	174.9	25091	52.0	12.1	8.7	7.0
200	2	178.1	23348	53.4	8.2	11.0	3.9
200	3	138.9	22303	55.5	9.9	6.2	3.8

Table 17. Data collected at trial 18 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	----------- (ppm N) ---------			
0	1	203.5	24742	22.7	6.9	5.4	2.4
0	2	179.5	22651	26.3	7.1	6.8	3.5
0	3	175.5	22303	30.1	11.0	8.2	5.4
25	1	179.4	21954	33.2	9.9	8.0	3.6
25	2	177.7	22303	28.1	9.8	5.0	4.5
25	3	181.1	23000	27.3	10.7	8.0	5.8
50	1	190.2	22303	41.7	6.9	4.3	3.2
50	2	177.8	22651	37.8	7.4	6.6	3.5
50	3	179.8	21257	52.4	10.1	7.0	3.2
75	1	174.2	21257	39.4	9.8	8.3	7.4
75	2	179.1	23000	33.8	10.7	7.2	3.7
75	3	178.5	20909	46.1	11.3	5.7	5.6
100	1	190.4	22651	55.4	9.9	23.0	6.1
100	2	187.0	23697	57.7	10.4	7.0	6.2
100	3	206.5	23348	58.3	12.7	10.5	5.9
150	1	202.6	24045	52.6	9.0	9.6	5.1
150	2	192.8	22303	55.8	13.6	9.9	6.5
150	3	190.5	22303	64.1	9.7	21.9	10.1
200	1	176.6	19863	49.9	12.1	15.1	6.7
200	2	184.5	21606	74.8	12.5	26.1	7.1
200	3	198.6	23348	52.0	8.9	7.2	4.8

Table 18. Data collected at trial 19 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	---------- (ppm N) ----------			
0	1	165.8	22009	22.9	4.4	2.8	2.0
0	2	143.7	23110	22.1	5.0	2.0	2.1
0	3	116.1	13756	19.9	4.2	3.0	2.0
25	1	162.4	26962	22.6	3.0	2.6	3.1
25	2	167.3	21459	31.7	14.1	2.2	2.0
25	3	173.0	24210	22.7	2.9	2.5	2.0
50	1	162.5	20634	32.6	5.9	3.4	2.0
50	2	176.4	23660	27.1	5.6	2.0	2.0
50	3	179.4	22834	27.8	4.8	2.2	2.0
75	1	161.8	23110	28.3	5.7	2.4	2.0
75	2	177.0	23385	40.5	4.9	5.0	2.6
75	3	185.1	22834	34.2	5.6	2.8	2.0
100	1	141.3	19258	49.6	6.5	2.2	2.0
100	2	191.2	23660	60.9	18.4	5.9	3.4
100	3	179.8	20909	36.0	5.5	4.2	2.0
150	1	197.6	24210	56.5	7.9	14.7	4.1
150	2	182.4	21459	40.2	6.2	5.1	2.4
150	3	162.9	20083	55.5	20.6	3.6	3.1
200	1	173.8	23935	69.3	14.6	7.9	3.4
200	2	200.4	24210	71.3	10.9	12.7	2.2
200	3	183.7	24210	37.0	8.0	6.6	2.0

Table 19. Data collected at trial 20 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	----------- (ppm N) ---------			
0	1	172.5	26136	30.6	4.7	5.3	2.5
0	2	185.9	23348	16.4	2.0	2.4	2.0
0	3	165.6	27181	27.3	6.3	2.8	2.0
25	1	170.5	25439	26.3	5.2	2.3	2.4
25	2	183.1	24394	32.0	5.9	2.2	2.2
25	3	178.3	25439	34.8	2.0	3.1	2.7
50	1	189.2	25439	37.7	2.0	3.6	2.0
50	2	167.7	24742	29.8	2.0	2.1	2.0
50	3	151.7	21954	34.8	5.8	4.6	3.2
75	1	174.1	24045	42.6	4.3	4.3	2.0
75	2	186.7	25439	39.8	8.2	4.4	5.0
75	3	185.4	25439	35.6	2.0	3.7	2.7
100	1	154.6	24394	59.7	6.2	4.0	2.0
100	2	197.3	25787	46.2	7.1	5.9	2.0
100	3	178.6	25439	48.9	4.8	5.1	3.4
150	1	195.4	25091	62.7	9.5	7.6	6.0
150	2	193.3	26136	45.2	4.7	7.8	2.3
150	3	199.6	24045	27.4	1.7	7.4	4.4
200	1	194.1	26136	100.9	29.9	17.8	5.7
200	2	178.8	27181	60.5	7.3	4.7	3.6
200	3	147.7	22303	38.8	3.4	6.4	6.8

Table 20. Data collected at trial 21 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	(ppm N)			
0	1	81.2	20212	18.0	3.7	ND[a]	2.7
0	2	73.7	22303	21.2	4.9	ND	3.6
0	3	85.3	23697	26.4	10.2	ND	3.0
25	1	81.2	20909	21.7	8.7	6.1	4.3
25	2	65.8	24045	29.5	7.8	7.4	4.9
25	3	81.6	23697	24.5	9.1	5.9	4.3
50	1	54.0	23348	34.0	8.1	6.0	3.5
50	2	77.6	21257	27.6	8.7	7.4	5.0
50	3	81.0	21954	22.8	6.7	5.8	5.6
75	1	65.9	22651	33.5	9.4	6.2	3.7
75	2	73.8	24394	36.1	8.1	9.6	5.6
75	3	76.9	23000	27.4	9.4	5.4	4.1
100	1	81.0	21954	49.3	11.3	7.8	4.5
100	2	69.3	20212	33.2	9.6	8.4	7.9
100	3	73.6	25091	36.4	9.4	5.8	3.9
150	1	70.7	21257	30.1	4.9	13.9	9.1
150	2	64.0	22651	41.4	10.0	9.7	6.6
150	3	82.0	22651	42.2	16.7	10.1	8.6
200	1	79.2	23348	49.7	11.3	32.1	9.8
200	2	71.4	21606	57.9	11.9	20.0	8.5
200	3	84.8	22303	48.3	9.9	18.5	7.1

[a] ND = not determined

Table 21. Data collected at trial 22 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	----------- (ppm N) ---------			
0	1	52.0	19863	28.7	4.3	3.5	2.8
0	2	38.6	24742	21.5	5.4	4.3	4.0
0	3	48.1	22651	25.5	3.6	3.9	3.2
25	1	55.1	24045	37.6	7.7	4.6	3.7
25	2	44.2	20212	29.5	8.9	6.7	4.5
25	3	49.6	14636	43.0	11.7	5.9	4.4
50	1	43.9	22651	26.2	7.5	4.7	3.4
50	2	44.9	23348	41.3	4.9	6.4	3.8
50	3	46.3	24394	41.3	3.6	4.7	2.1
75	1	53.7	22651	24.1	4.3	5.1	2.9
75	2	51.1	21954	48.3	12.2	5.1	4.7
75	3	48.2	21954	43.2	4.4	6.0	3.5
100	1	50.5	20212	45.0	45.5	3.9	20.5
100	2	51.3	21954	56.1	4.6	24.9	4.1
100	3	49.5	19166	38.3	17.7	5.9	19.6
150	1	52.4	21954	42.6	5.2	12.8	3.0
150	2	51.9	23697	52.6	6.3	36.7	6.9
150	3	53.3	21257	28.6	6.6	6.2	5.8
200	1	54.9	21606	45.7	11.0	23.6	8.1
200	2	57.4	23000	69.9	7.0	38.9	7.7
200	3	48.2	21954	41.6	3.8	9.7	3.2

Table 22. Data collected at trial 23 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	183.7	23595	19.5	ND[a]	6.6	ND	2009
0	2	202.7	22869	20.6	ND	5.8	ND	1648
0	3	189.8	22506	19.4	ND	5.5	ND	2551
25	1	207.2	23958	22.1	ND	6.2	ND	3161
25	2	182.3	21054	20.5	ND	3.7	ND	3284
25	3	191.4	23595	15.6	ND	6.9	ND	745
50	1	189.7	24321	25.1	ND	6.3	ND	3163
50	2	188.2	21417	23.0	ND	3.3	ND	1603
50	3	195.6	23595	52.7	ND	5.8	ND	5518
75	1	204.4	23232	35.8	ND	6.2	ND	4468
75	2	185.2	22869	26.2	ND	7.2	ND	2392
75	3	193.3	21780	30.1	ND	4.9	ND	5108
100	1	206.1	22506	42.3	ND	7.5	ND	4014
100	2	180.0	23232	23.5	ND	5.8	ND	3270
100	3	173.9	21780	42.8	ND	8.0	ND	4510
150	1	192.4	23232	38.3	ND	3.8	ND	3408
150	2	175.0	22506	46.4	ND	5.2	ND	5479
150	3	189.8	25047	49.8	ND	8.1	ND	3983
200	1	194.6	25410	45.5	ND	8.9	ND	4203
200	2	201.0	22143	49.7	ND	6.5	ND	4859
200	3	181.9	23958	46.5	ND	8.2	ND	4708

[a] ND = Not determined

Table 23. Data collected at trial 24 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	-------------		(ppm N)		--------------
0	1	144.6	21184	8.9	8.7	4.8	3.5	129
0	2	115.2	20634	9.5	6.6	4.6	1.7	146
0	3	106.5	18433	9.8	8.3	5.0	2.0	110
25	1	131.2	21184	12.1	6.9	4.1	1.5	140
25	2	139.0	22009	9.0	8.9	5.5	2.5	109
25	3	137.6	21734	11.2	9.0	4.8	2.9	114
50	1	144.0	20634	16.1	11.5	4.3	2.6	1051
50	2	139.3	20634	14.7	7.5	3.6	1.0	119
50	3	145.7	21459	11.3	12.8	5.0	2.5	229
75	1	140.2	21459	15.3	9.6	4.4	1.6	101
75	2	124.6	21459	9.6	7.1	4.3	1.3	232
75	3	160.9	21184	17.3	14.9	4.1	1.7	1305
100	1	125.2	21734	12.7	9.3	4.8	1.8	137
100	2	131.4	20634	22.3	18.5	7.0	2.6	1531
100	3	152.3	22834	16.3	11.1	4.6	2.9	584
150	1	146.9	23660	27.0	17.2	5.0	2.7	2111
150	2	154.7	20634	24.2	16.3	5.6	1.8	1876
150	3	146.8	20634	15.6	10.6	4.9	2.1	1879
200	1	140.6	22284	28.9	16.3	6.5	3.9	1806
200	2	151.5	22009	28.7	19.1	4.9	3.6	2924
200	3	154.9	20909	17.6	10.5	5.2	1.1	3715

Table 24. Data collected at trial 25 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	---------- (ppm N) ----------			
0	1	156.5	23000	14.5	19.5	6.6	4.6
0	2	157.5	21606	22.1	15.9	8.2	3.7
0	3	161.5	22303	22.3	16.9	5.4	6.3
25	1	173.0	24742	15.4	19.0	8.5	4.4
25	2	167.3	23348	19.5	15.1	5.1	2.9
25	3	155.1	23000	16.2	16.8	8.7	3.7
50	1	159.1	22303	25.6	22.5	9.7	5.6
50	2	170.7	25091	22.9	20.2	6.2	3.6
50	3	147.8	23697	18.8	19.3	8.3	4.3
75	1	164.4	23348	38.1	21.2	10.6	8.6
75	2	165.3	24742	29.3	15.1	6.3	2.8
75	3	168.9	23000	32.4	21.1	8.2	4.8
100	1	159.3	20560	40.4	17.7	7.7	3.2
100	2	169.9	23348	24.4	26.7	7.1	8.6
100	3	165.0	24394	32.9	29.3	13.3	7.2
150	1	157.8	22651	26.1	17.4	6.8	5.3
150	2	154.1	22651	42.3	18.5	1.1	5.2
150	3	158.0	21606	36.8	28.2	19.6	8.1
200	1	171.3	25091	59.5	17.7	49.0	3.1
200	2	147.8	22651	49.8	19.2	9.1	2.8
200	3	166.7	22303	39.7	13.2	33.4	5.3

Table 25. Data collected at trial 26 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	-------------		(ppm N)		--------------
0	1	171.5	22303	12.5	6.5	6.0	4.4	131
0	2	169.3	20560	20.1	9.7	5.4	5.3	3087
0	3	182.1	23348	14.0	9.0	4.5	4.7	3004
25	1	169.0	19863	15.9	11.7	6.7	5.9	1402
25	2	167.8	20212	18.5	12.3	5.7	6.2	2482
25	3	162.0	21954	12.7	9.4	5.5	5.8	110
50	1	172.7	21954	18.2	14.9	7.7	3.7	2474
50	2	168.4	18818	19.9	12.5	6.8	4.1	3051
50	3	152.5	22303	10.8	4.0	5.0	2.9	241
75	1	169.2	21606	34.8	10.4	4.6	6.1	4738
75	2	172.1	21606	23.3	12.1	7.5	3.9	1534
75	3	177.4	20560	15.6	9.4	5.4	3.4	98
100	1	169.0	21606	19.8	8.0	4.9	3.7	1945
100	2	183.2	21954	23.9	10.0	7.3	3.7	3278
100	3	188.5	24045	34.9	16.4	5.2	7.4	5760
150	1	189.5	21606	44.6	12.9	5.7	4.6	6255
150	2	172.0	19515	21.5	9.9	5.4	3.0	3430
150	3	197.9	24394	31.5	13.1	6.8	6.7	7235
200	1	155.2	18121	46.0	17.8	8.0	7.1	7101
200	2	192.2	23000	39.4	13.0	4.9	3.2	5736
200	3	191.5	21606	37.6	22.0	5.6	3.5	6159

Table 26. Data collected at trial 27 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	161.2	23385	17.7	18.1	6.1	4.6	7947
0	2	163.8	23660	19.9	13.9	5.1	2.8	5277
0	3	164.7	22009	21.6	13.8	5.3	3.8	5713
25	1	158.0	23385	16.6	17.5	6.6	3.7	7318
25	2	158.8	22834	22.1	13.5	5.8	3.4	4673
25	3	173.5	25311	25.1	15.3	6.8	4.1	7015
50	1	155.1	21184	25.4	12.1	6.9	3.0	7944
50	2	158.7	21734	41.3	21.8	7.8	4.9	9341
50	3	169.6	25036	34.7	17.6	7.3	4.3	8619
75	1	153.6	22560	28.5	18.2	6.6	4.4	4861
75	2	156.5	23110	32.3	16.1	6.2	3.4	7639
75	3	158.8	21734	35.2	21.0	7.4	5.3	9725
100	1	169.0	22560	38.7	16.9	6.6	3.1	7633
100	2	171.6	22560	35.8	17.1	7.6	3.4	10143
100	3	161.1	23385	31.7	13.4	7.2	4.2	7317
150	1	173.2	23660	34.1	14.2	12.2	2.6	11479
150	2	167.0	25311	32.7	27.3	10.9	7.9	10569
150	3	172.8	25586	41.8	13.9	15.7	4.7	7340
200	1	168.4	23110	58.6	16.8	12.3	6.9	9001
200	2	165.5	22560	49.1	14.6	20.2	4.0	10569
200	3	170.3	24485	45.9	23.0	14.7	5.5	8972

Table 27. Data collected at trial 28 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	181.8	24394	27.3	16.9	5.1	3.0	3806
0	2	183.2	24394	19.0	11.3	4.2	2.4	3809
0	3	176.2	20038	18.4	13.0	4.3	3.4	4853
25	1	178.0	23813	20.6	9.0	6.9	3.7	4324
25	2	176.4	25265	22.3	13.2	4.5	3.0	4296
25	3	177.0	22651	25.7	10.0	5.8	5.7	4683
50	1	182.5	21780	28.9	14.6	6.0	3.0	5069
50	2	179.6	24103	33.4	11.3	5.8	2.5	4897
50	3	178.4	20909	32.0	14.0	6.5	3.4	6449
75	1	191.5	24394	25.5	14.4	5.7	3.0	5061
75	2	189.7	23522	31.0	28.2	5.8	7.7	6671
75	3	183.9	22942	26.9	11.9	5.6	4.4	6207
100	1	182.2	22651	33.8	10.8	7.7	4.2	5733
100	2	193.9	23813	28.6	13.7	9.0	3.5	7587
100	3	173.7	21199	37.8	11.0	5.0	3.8	4301
150	1	189.8	23522	59.5	15.7	15.8	6.1	5688
150	2	187.9	24394	46.5	51.9	11.5	11.8	13445
150	3	184.5	23522	42.0	7.0	8.5	4.1	4487
200	1	183.6	23522	41.0	15.8	7.4	4.3	6192
200	2	169.6	20618	35.2	13.7	9.7	4.9	7283
200	3	179.5	23813	41.3	16.2	10.7	7.4	5713

Table 28. Data collected at trial 29 for first-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	-------------	-------------	(ppm N)	--------------	--------------
0	1	174.5	23697	24.9	14.1	5.9	3.3	6481
0	2	175.9	22651	23.0	21.4	7.7	4.0	5969
0	3	184.5	20909	23.6	21.0	7.3	4.5	8966
25	1	184.1	24394	22.6	12.8	6.7	3.6	6212
25	2	194.4	23697	32.1	19.1	9.2	5.0	9737
25	3	195.4	24742	21.1	12.2	7.7	4.1	10149
50	1	182.7	22651	31.0	14.0	8.0	5.3	7315
50	2	182.1	22303	41.3	15.5	6.8	3.2	7029
50	3	186.5	23348	32.6	16.8	9.5	6.2	8636
75	1	181.9	22651	39.4	13.7	6.8	4.4	9354
75	2	193.2	25439	46.8	13.6	7.3	4.3	14093
75	3	184.8	23697	44.7	17.2	9.6	6.4	7317
100	1	190.8	23000	36.0	19.5	8.0	5.2	8972
100	2	176.9	23000	40.7	18.1	9.7	4.2	7955
100	3	178.7	22651	48.0	14.0	6.8	3.6	12406
150	1	169.4	23000	34.4	16.0	7.5	5.7	7947
150	2	170.5	24394	52.2	18.4	8.6	5.4	10584
150	3	181.1	23697	58.9	18.5	12.4	5.0	8285
200	1	184.0	23000	63.9	20.2	13.3	4.4	12483
200	2	189.1	24742	72.2	15.6	15.7	4.0	19560
200	3	177.1	23000	55.1	17.1	8.9	4.8	8975

Table 29. Data collected at trial 30 for first-year corn after alflafa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	156.4	23697	3.8	7.7	5.1	3.2	1207
0	2	167.2	23348	3.2	6.7	4.4	2.3	533
0	3	145.5	24394	2.3	7.6	5.4	3.6	228
25	1	159.2	25439	11.0	14.9	4.0	2.2	4597
25	2	166.3	24742	4.7	8.6	4.8	3.1	2408
25	3	165.8	24394	9.6	16.3	6.2	1.6	4243
50	1	160.3	24742	18.2	15.3	6.3	2.6	10412
50	2	159.9	23348	6.3	10.7	4.8	1.8	1577
50	3	170.0	23697	9.4	22.1	14.6	8.3	3745
75	1	167.4	23697	16.0	14.5	4.0	1.2	7179
75	2	163.3	24394	17.6	14.1	7.2	3.0	6924
75	3	173.6	24394	6.1	14.4	4.2	2.7	885
100	1	163.4	25787	15.2	15.6	5.1	2.3	6374
100	2	169.8	24045	7.5	14.2	5.0	1.6	3069
100	3	160.3	25439	2.6	6.7	3.5	1.8	886
150	1	173.5	26485	6.3	8.3	5.1	2.4	965
150	2	167.2	23697	19.0	21.4	6.4	3.3	7195
150	3	158.7	24394	3.7	8.9	3.9	2.4	441
200	1	173.9	23697	8.8	15.2	6.1	3.6	1940
200	2	180.4	23348	35.3	24.0	8.2	2.8	6383
200	3	165.7	25091	5.6	12.6	3.9	1.9	4408

Table 30. Data collected at trial 2 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	120.2	24210	18.1	7.7	4.0	2.3	456
0	2	97.9	24760	17.3	6.8	4.3	2.6	992
0	3	98.1	23660	13.6	8.5	5.2	1.9	604
25	1	94.9	22834	15.3	8.5	5.1	4.3	679
25	2	86.2	22560	18.3	12.5	7.0	4.0	1312
25	3	90.1	24485	17.0	12.4	5.1	3.9	909
50	1	85.8	22284	18.9	7.9	5.4	3.6	2872
50	2	102.6	23110	21.5	17.4	5.5	4.9	628
50	3	92.6	21459	21.1	9.6	5.6	2.5	1267
75	1	95.1	22834	24.8	9.8	5.9	4.3	1427
75	2	87.5	24485	23.4	20.0	4.4	4.0	1113
75	3	81.5	22834	21.6	11.0	6.3	3.9	2645
100	1	113.9	23110	26.9	17.2	7.1	5.0	1615
100	2	115.1	23385	27.1	16.8	3.8	3.4	1756
100	3	93.8	24485	24.2	11.5	8.3	3.7	1484
125	1	95.1	23660	34.5	23.9	7.9	5.0	1893
125	2	95.6	22834	26.3	15.0	5.6	4.1	1603
125	3	112.6	23935	31.3	11.8	5.6	3.3	1361
150	1	78.2	23935	32.5	12.6	7.6	4.5	3663
150	2	93.7	23660	29.4	11.2	8.2	3.2	2235
150	3	79.7	20909	22.1	12.2	8.6	3.4	3103
200	1	121.7	24210	37.2	23.2	8.2	4.4	1976
200	2	112.2	25311	39.4	19.3	6.9	4.7	4294
200	3	101.9	24760	25.9	9.8	5.5	1.8	3229
250	1	85.7	21459	33.3	26.2	9.8	12.0	2350
250	2	87.1	22560	39.2	11.9	10.6	6.8	3512
250	3	101.8	21734	33.5	12.9	6.5	2.0	2648
300	1	103.1	23935	45.9	18.6	11.0	5.7	3358
300	2	66.7	20634	55.3	18.4	19.7	9.6	3236
300	3	46.9	20083	35.9	17.4	11.0	4.4	4839

Table 31. Data collected at trial 3 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	(ppm N)			
0	1	63.1	15333	11.9	8.4	3.7	2.2
0	2	93.6	25439	18.4	11.3	6.3	3.1
0	3	63.4	14288	13.9	9.3	3.3	2.1
25	1	66.3	14288	15.1	11.6	3.5	3.4
25	2	88.1	28227	18.0	12.5	3.1	3.4
25	3	117.8	21606	16.9	10.2	3.1	4.8
50	1	87.4	26485	27.7	11.2	4.4	2.3
50	2	101.8	24045	32.4	10.4	5.6	4.0
50	3	64.5	13242	26.8	10.1	7.4	3.9
75	1	55.0	14636	29.6	12.4	7.1	3.4
75	2	81.0	16030	17.7	12.4	4.8	3.9
75	3	83.2	25439	25.1	12.4	3.6	3.6
100	1	105.0	25439	24.1	13.5	4.9	5.4
100	2	75.7	16030	30.0	13.2	9.3	9.2
100	3	83.9	24045	35.9	13.7	8.9	3.8
125	1	85.1	24394	12.2	10.9	4.7	3.4
125	2	107.2	28924	25.1	14.6	2.9	3.3
125	3	105.1	20212	32.0	12.4	12.1	4.2
150	1	94.9	22651	34.0	10.7	8.6	4.7
150	2	71.4	20560	26.4	18.7	3.7	8.2
150	3	86.2	25439	42.3	17.8	8.9	6.3
200	1	104.8	25787	47.1	14.3	17.5	8.3
200	2	94.0	18121	30.4	15.2	7.7	5.8
200	3	86.0	26485	37.8	29.2	13.8	16.4
250	1	78.9	26833	58.9	28.9	28.9	13.2
250	2	79.8	18818	53.5	19.7	20.4	11.4
250	3	111.8	29272	29.3	17.0	7.4	5.8
300	1	100.0	28227	42.5	28.4	16.8	21.8
300	2	76.6	27181	66.3	18.0	17.0	9.9
300	3	70.1	17076	44.8	44.8	10.4	24.0

Table 32. Data collected at trial 4 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	----------------		(ppm N)	------------	
0	1	97.5	24742	15.5	10.2	6.0	4.0	992
0	2	106.2	24394	19.6	12.0	2.9	3.3	685
0	3	89.9	25091	17.8	9.1	3.7	3.0	517
25	1	102.2	22303	19.8	13.5	3.1	4.0	1372
25	2	104.3	24045	16.1	12.6	4.2	3.3	556
25	3	ND	23348	21.1	11.2	2.6	1.9	71
50	1	93.8	23348	28.4	9.7	6.1	2.9	1689
50	2	95.4	19863	23.6	12.8	2.8	4.0	1322
50	3	85.9	22651	18.7	14.8	3.3	2.5	1327
75	1	105.8	22303	25.4	13.0	2.4	2.6	2996
75	2	88.6	25091	30.6	14.6	8.0	4.0	2156
75	3	91.5	22651	26.1	14.4	3.0	3.5	3013
100	1	88.2	22303	30.9	14.6	3.0	2.8	3112
100	2	91.3	19515	22.8	20.0	5.2	4.3	3107
100	3	77.9	23348	26.1	11.7	4.8	3.0	1423
125	1	ND	24742	39.0	13.3	4.2	2.4	3517
125	2	91.0	23000	35.8	15.7	5.4	3.7	3234
125	3	101.9	25439	41.5	15.2	4.3	3.9	2971
150	1	94.8	22303	30.4	23.9	3.9	8.4	3104
150	2	92.0	17424	47.7	12.9	9.7	4.1	4163
150	3	76.9	20560	38.7	11.6	5.8	3.1	3979
200	1	106.3	23000	27.0	20.6	4.2	6.0	5284
200	2	ND	23000	32.0	14.7	3.5	5.1	2523
200	3	58.7	10803	42.3	11.7	21.5	4.8	5511
250	1	105.1	24742	41.6	14.3	6.3	4.6	3241
250	2	98.8	23000	50.7	13.7	5.4	3.7	4314
250	3	92.2	24045	39.3	16.1	9.4	5.2	3962
300	1	92.2	17772	52.6	12.8	21.7	4.9	5542
300	2	91.3	18470	59.3	13.1	30.3	7.4	4694
300	3	92.2	23697	30.5	30.0	8.3	14.3	4887

Table 33. Data collected at trial 5 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	67.7	24394	21.2	8.8	3.7	2.5	1971
0	2	61.1	25439	18.4	8.3	3.1	2.5	1425
0	3	64.2	20212	16.1	7.3	3.6	1.7	1821
25	1	69.3	24742	22.9	8.7	3.5	1.4	2322
25	2	88.0	23000	26.1	11.2	5.1	2.3	2324
25	3	48.3	23000	25.7	9.3	3.6	1.8	1915
50	1	72.0	18121	27.3	10.9	3.2	1.3	2511
50	2	80.2	23697	31.9	13.8	5.0	4.2	3778
50	3	62.8	24394	24.1	13.0	3.1	2.1	3625
75	1	64.0	23348	34.7	12.5	27.5	2.4	3656
75	2	96.4	21954	28.7	9.4	4.9	1.8	2416
75	3	89.7	24045	33.7	13.2	4.9	2.5	3635
100	1	76.9	23348	36.0	14.4	3.6	3.1	4861
100	2	68.5	23000	29.9	17.5	4.9	4.0	3233
100	3	90.8	23348	30.3	18.0	3.8	2.9	1985
125	1	56.2	23697	40.8	11.5	5.9	2.3	4140
125	2	88.3	23348	38.7	17.9	4.5	4.9	2989
125	3	57.2	24742	34.1	13.5	4.5	4.2	2975
150	1	86.1	23000	42.8	14.3	3.7	2.4	3995
150	2	85.3	19515	41.3	13.5	4.9	3.8	3392
150	3	79.6	14636	39.8	13.0	6.0	3.0	3519
200	1	76.3	21954	42.3	26.8	4.7	4.9	3968
200	2	60.5	25787	46.8	14.9	6.9	3.1	3974
200	3	77.1	14985	44.6	14.3	8.9	4.4	4879
250	1	88.7	24394	56.2	21.7	12.2	4.3	5316
250	2	83.9	22303	51.3	24.8	6.2	6.1	6487
250	3	89.7	20212	69.1	26.7	17.6	7.0	4687
300	1	81.2	22303	46.7	13.6	6.0	3.6	5744
300	2	83.7	18470	49.7	12.7	19.4	3.2	5083
300	3	85.4	19166	48.1	15.5	8.5	5.2	4496

Table 34. Data collected at trial 6 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	----------------	(ppm N)		------------	
0	1	65.1	23000	15.1	6.2	4.1	1.2	103
0	2	71.2	25091	14.7	8.5	3.7	2.2	80
0	3	85.2	25091	14.9	4.5	5.5	1.9	94
25	1	78.1	22303	13.9	6.6	3.7	1.2	91
25	2	98.1	23697	21.6	9.2	6.3	2.2	91
25	3	76.3	22651	18.1	8.8	2.8	1.0	132
50	1	88.2	24394	25.8	8.1	3.1	0.5	107
50	2	106.4	25787	24.9	7.7	3.4	1.2	565
50	3	76.2	24742	23.5	20.2	3.3	1.2	116
75	1	75.4	24394	24.5	10.5	3.3	0.9	2329
75	2	101.8	24742	27.8	9.9	4.2	1.6	2491
75	3	85.6	24742	33.1	10.2	8.9	1.9	937
100	1	70.3	23000	33.3	8.2	4.5	1.0	1199
100	2	95.8	22303	38.5	17.8	4.4	2.3	3299
100	3	103.1	23348	49.1	12.5	5.6	1.8	1468
125	1	97.8	22303	35.5	15.7	3.9	1.4	4582
125	2	92.6	23697	36.7	9.1	4.4	2.8	2388
125	3	78.1	23697	29.1	12.6	8.8	6.7	1866
150	1	98.3	24742	41.2	15.3	4.7	1.6	3882
150	2	105.9	25091	28.7	13.2	4.9	2.7	3446
150	3	94.7	23000	44.8	10.6	23.1	1.9	6086
200	1	88.7	23348	44.1	27.1	5.7	2.3	6081
200	2	99.3	23000	46.2	13.2	4.8	1.5	5167
200	3	95.3	23697	35.4	18.0	8.5	4.0	4035
250	1	107.3	23348	64.8	12.4	6.5	1.6	6092
250	2	117.2	23697	54.9	12.0	4.7	2.4	6577
250	3	97.9	23348	58.4	8.7	17.0	2.8	6858
300	1	89.6	23348	61.6	35.1	10.8	3.8	6331
300	2	100.5	23697	68.2	13.3	14.1	3.6	7148
300	3	109.1	24045	58.8	18.2	24.7	4.0	7134

Table 35. Data collected at trial 8 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	71.5	20909	19.0	20.8	6.2	2.6	11313
0	2	67.7	20212	28.2	17.4	5.4	1.0	12274
0	3	56.0	21606	29.1	23.6	5.7	2.5	9977
25	1	74.0	20560	19.3	16.2	4.1	2.7	11329
25	2	75.8	21954	31.9	21.2	4.2	2.2	10825
25	3	64.6	20560	28.2	20.4	5.1	1.3	16358
50	1	65.4	21954	26.2	21.9	6.4	2.5	11297
50	2	52.2	20909	40.1	39.0	4.3	3.8	13854
50	3	61.8	21954	23.8	21.6	4.7	2.6	13879
75	1	86.7	20212	34.9	18.2	6.5	1.0	10836
75	2	44.5	22651	36.3	41.3	6.0	5.5	8822
75	3	55.8	22303	39.3	26.0	6.0	2.3	9579
100	1	61.9	21954	27.0	18.8	5.9	4.3	11017
100	2	56.0	24742	47.5	35.7	11.7	3.0	16572
100	3	80.8	23000	31.2	22.7	5.3	4.8	14708
125	1	84.0	19166	43.8	29.8	5.9	2.0	15330
125	2	81.1	20909	42.3	26.3	6.1	5.8	13589
125	3	54.2	21954	40.8	24.6	6.4	2.8	14713
150	1	56.9	18470	46.2	28.5	6.8	4.5	20395
150	2	73.7	21606	36.1	21.2	6.9	4.4	8326
150	3	77.3	23697	43.9	25.1	10.9	4.9	15296
200	1	64.5	24045	59.0	23.0	8.3	2.6	17276
200	2	73.9	21606	75.9	21.7	13.2	1.8	17356
200	3	52.3	21257	53.4	24.6	14.9	6.6	14102
250	1	80.1	20909	58.7	32.2	13.6	4.1	15376
250	2	86.4	21954	69.0	38.1	15.1	6.1	16004
250	3	53.7	21954	72.6	30.6	26.3	9.7	13559
300	1	38.2	21954	67.2	28.1	27.4	7.4	13022
300	2	65.8	22651	48.3	27.9	18.7	12.0	18022
300	3	64.5	23348	70.1	29.2	18.9	5.3	14787

Table 36. Data collected at trial 9 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	---------- (ppm N)			---------
0	1	141.4	22651	17.8	15.2	4.0	2.2
0	2	125.0	20909	16.9	13.0	10.5	2.8
0	3	126.5	21606	26.7	25.4	7.6	5.3
25	1	136.0	20560	19.2	18.3	9.6	2.9
25	2	142.2	21954	21.2	18.1	7.6	3.9
25	3	120.8	20909	22.9	22.9	4.8	5.4
50	1	132.8	20212	27.1	13.0	5.4	2.0
50	2	138.9	21257	23.5	15.7	5.5	3.3
50	3	113.0	17424	30.5	13.2	10.4	2.4
75	1	138.3	22651	34.5	26.4	13.4	8.7
75	2	137.2	19515	31.7	21.4	14.6	11.6
75	3	127.4	20560	22.7	14.6	6.4	2.4
100	1	129.4	20212	30.8	15.8	8.6	3.8
100	2	138.0	21954	25.9	15.7	8.9	4.0
100	3	119.9	18818	35.0	15.5	11.4	2.9
125	1	148.0	21606	38.5	22.2	15.4	4.6
125	2	122.8	19515	26.5	12.6	21.4	5.9
125	3	119.0	22303	30.9	21.2	7.2	4.1
150	1	141.8	18818	31.5	20.1	14.6	6.2
150	2	139.8	20909	31.5	18.9	17.3	8.7
150	3	128.6	20560	30.4	15.9	14.1	6.3
200	1	139.8	20212	44.2	18.4	19.1	9.0
200	2	134.4	20560	45.2	19.2	12.7	6.0
200	3	139.3	21954	48.8	20.1	27.9	6.5
250	1	136.6	20909	39.9	19.3	34.2	8.6
250	2	126.9	14985	50.4	18.1	44.5	11.9
250	3	126.0	21606	38.9	20.3	24.0	11.3
300	1	142.6	19515	39.2	22.1	29.8	16.5
300	2	136.4	19166	32.6	17.1	22.4	8.7
300	3	136.0	19166	48.7	23.4	50.2	13.3

Table 37. Data collected at trial 10 for second year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	158.7	24103	20.3	9.2	3.6	2.5	367
0	2	158.8	24394	20.7	9.1	3.5	2.0	288
0	3	127.6	22651	31.4	17.0	3.3	2.5	1648
25	1	138.5	22651	26.7	12.1	3.4	2.5	1863
25	2	128.1	20909	32.0	14.4	2.4	2.0	3414
25	3	123.7	22070	29.5	7.4	4.7	2.3	2290
50	1	135.9	22361	56.0	12.1	5.3	2.7	4553
50	2	131.7	21199	31.0	9.0	4.7	2.0	793
50	3	141.5	23522	31.4	17.5	6.3	3.3	2804
75	1	150.4	21780	38.5	12.0	5.0	2.8	3153
75	2	125.9	21199	37.9	27.9	5.2	4.1	2582
75	3	132.5	21199	40.2	8.0	7.5	1.8	2693
100	1	137.3	24684	36.5	8.6	6.3	2.1	4208
100	2	119.8	24103	27.1	8.8	6.1	2.3	2692
100	3	153.9	22361	42.8	9.1	7.4	2.4	2699
125	1	147.2	24103	54.4	14.2	7.2	4.1	6081
125	2	129.1	23522	44.5	12.2	6.6	2.0	5594
125	3	154.5	24103	46.0	10.0	8.0	2.6	4585
150	1	133.7	22651	48.6	27.7	13.4	6.7	3113
150	2	121.9	22070	55.8	14.9	8.6	2.7	2876
150	3	143.1	23232	61.0	10.5	10.9	1.8	2861
200	1	134.7	23522	36.6	13.0	7.2	4.0	3978
200	2	143.4	24103	56.0	12.1	23.8	4.5	4509
200	3	128.1	23232	62.2	8.4	10.5	1.6	2443
250	1	138.7	22942	52.6	14.7	17.4	6.0	4144
250	2	139.0	22070	45.1	11.2	19.4	4.6	2757
250	3	139.2	23813	52.8	10.9	7.6	3.0	4681
300	1	104.5	22070	93.0	12.9	44.9	2.8	6758
300	2	133.9	24103	90.1	16.2	37.9	3.9	8616
300	3	142.3	21780	74.1	13.8	12.9	3.1	3512

Table 38. Data collected at trial 11 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	----------------		(ppm N)	------------	
0	1	159.3	23522	15.3	11.5	3.0	2.7	199
0	2	156.9	24684	21.7	10.8	3.7	2.0	200
0	3	156.4	24394	15.5	11.1	4.6	2.5	290
25	1	158.5	24974	24.2	11.6	2.3	2.9	355
25	2	154.6	23232	24.5	12.4	3.3	2.2	471
25	3	142.0	24394	26.6	9.9	5.2	2.2	207
50	1	156.8	24684	29.1	13.1	4.1	2.0	1214
50	2	161.5	25265	25.5	9.0	3.1	2.0	370
50	3	159.7	24394	33.3	14.4	5.6	4.5	838
75	1	160.6	23232	27.5	10.8	3.4	2.7	1312
75	2	168.7	23522	36.6	18.3	5.4	2.6	3272
75	3	151.6	22942	45.5	9.9	5.4	3.4	1597
100	1	163.0	24394	46.6	12.9	10.7	1.5	2136
100	2	168.5	23522	43.2	14.4	3.4	2.0	2806
100	3	162.2	25846	41.9	13.2	11.7	2.9	2591
125	1	153.2	24394	58.5	12.2	6.4	2.3	4992
125	2	179.2	24684	56.4	17.0	4.9	2.0	3754
125	3	165.1	24684	48.5	12.0	8.3	4.4	6096
150	1	174.7	24974	54.9	15.9	8.3	2.3	2212
150	2	176.8	23232	37.1	14.9	4.3	2.0	5388
150	3	160.5	23813	51.8	11.4	5.7	2.9	3317
200	1	171.0	23522	45.3	10.9	8.8	2.1	5641
200	2	165.3	24103	103.2	13.4	8.8	2.2	6348
200	3	171.2	23522	68.9	13.7	19.6	2.0	4094
250	1	167.2	24974	75.1	14.1	18.8	2.6	6124
250	2	153.5	27298	106.5	10.9	26.6	2.0	5166
250	3	163.3	24684	62.9	13.3	12.4	2.7	4250
300	1	176.5	23813	57.2	14.4	8.6	2.7	4981
300	2	151.0	24394	68.6	21.7	10.1	2.0	4252
300	3	160.6	24684	59.2	11.5	13.1	3.2	6625

Table 39. Data collected at trial 12 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	---------- (ppm N)			---------
0	1	164.9	20212	18.9	10.8	3.4	2.3
0	2	178.8	22651	19.6	12.3	3.9	4.2
0	3	170.3	23348	20.5	12.3	3.4	2.4
25	1	133.3	13591	26.1	14.0	4.8	4.0
25	2	107.5	13939	19.7	11.7	4.5	3.4
25	3	181.3	25787	34.7	15.6	4.2	2.1
50	1	132.0	12545	31.5	13.5	6.1	4.1
50	2	190.6	26136	38.6	13.3	4.3	2.5
50	3	175.7	23348	30.6	19.6	3.1	5.3
75	1	167.1	20909	51.8	17.3	7.1	3.7
75	2	180.5	24394	39.4	16.0	5.9	3.9
75	3	176.5	23348	38.5	21.7	4.4	3.7
100	1	157.3	16727	49.1	16.1	6.7	5.0
100	2	181.1	24742	39.0	12.7	5.7	4.8
100	3	132.8	21954	59.6	17.4	10.8	4.6
125	1	189.3	26136	61.2	37.7	8.1	9.8
125	2	141.2	13939	44.8	22.9	5.5	7.1
125	3	152.8	21606	47.4	15.6	11.1	4.4
150	1	191.0	26485	51.7	16.5	8.0	4.7
150	2	180.5	21954	58.5	16.2	10.4	3.6
150	3	168.6	17076	58.4	20.0	18.8	8.1
200	1	167.2	23348	54.5	21.4	14.4	6.1
200	2	186.1	23697	71.9	20.3	13.8	5.9
200	3	174.7	25439	61.3	15.5	23.5	4.7
250	1	162.1	23697	65.4	19.8	20.6	9.4
250	2	170.6	23348	53.6	29.9	20.8	20.8
250	3	165.6	21954	59.5	17.9	20.7	8.9
300	1	155.2	19515	57.1	16.3	35.7	11.6
300	2	135.6	15333	57.9	18.0	29.3	9.7
300	3	146.2	14985	57.1	19.9	27.0	8.6

Table 40. Data collected at trial 13 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	----------- (ppm N) ---------			
0	1	147.3	23385	19.1	26.6	4.6	4.9
0	2	120.7	23110	26.5	11.1	3.6	3.7
0	3	137.4	23110	19.8	11.3	4.1	3.8
25	1	138.5	22560	22.6	10.4	6.4	3.8
25	2	121.1	22009	30.0	9.2	4.6	5.5
25	3	140.5	22009	30.5	17.1	4.1	5.3
50	1	126.3	22834	40.0	13.1	6.4	4.4
50	2	140.2	23385	29.0	9.3	12.1	3.9
50	3	140.9	21184	37.9	10.4	7.6	3.9
75	1	133.3	23385	36.5	9.8	3.7	3.8
75	2	133.7	24210	29.4	13.3	6.7	5.9
75	3	135.8	21459	33.0	7.6	8.5	4.0
100	1	135.4	19809	64.1	24.8	8.2	8.2
100	2	136.3	24210	52.0	14.0	8.8	4.1
100	3	122.4	22834	35.7	13.2	11.3	4.5
125	1	157.3	23935	45.9	16.5	8.3	5.6
125	2	154.8	22834	57.6	18.6	14.0	4.2
125	3	157.3	22834	42.5	17.1	8.9	6.3
150	1	138.3	19809	49.4	30.2	17.9	7.0
150	2	124.4	20083	38.6	23.9	21.9	12.6
150	3	156.4	20634	60.2	17.3	22.7	4.0
200	1	146.0	22009	54.2	13.5	15.5	4.9
200	2	153.8	23110	45.7	15.4	35.7	9.1
200	3	110.0	19533	40.5	26.4	45.7	16.0
250	1	ND	ND	ND	ND	ND	ND
250	2	ND	ND	ND	ND	ND	ND
250	3	ND	ND	ND	ND	ND	ND
300	1	ND	ND	ND	ND	ND	ND
300	2	ND	ND	ND	ND	ND	ND
300	3	ND	ND	ND	ND	ND	ND

Table 41. Data collected at trial 14 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.
(lb/a)		(bu/a)	(pl/a)	(ppm N)			
0	1	156.7	20634	17.1	14.3	2.7	2.9
0	2	174.8	23385	22.1	23.2	4.4	2.3
0	3	169.0	21459	19.0	21.1	6.7	2.0
25	1	160.2	21184	19.9	13.4	3.3	2.0
25	2	171.7	21459	20.9	16.3	5.7	2.7
25	3	172.1	21459	22.7	27.2	4.4	2.1
50	1	171.4	19258	27.7	14.9	3.9	2.1
50	2	178.5	22284	29.6	20.3	6.0	2.7
50	3	188.5	23660	26.0	21.9	4.0	2.4
75	1	175.0	22009	31.8	22.4	3.8	2.0
75	2	161.6	23385	34.0	19.6	5.2	2.0
75	3	166.1	21734	34.8	26.1	5.4	2.0
100	1	168.0	19533	37.1	17.7	5.5	2.5
100	2	171.7	20359	35.4	24.6	4.5	2.2
100	3	171.0	22284	43.5	21.3	7.7	2.7
125	1	164.2	20359	61.2	33.8	4.4	2.4
125	2	174.8	22560	40.8	18.5	4.8	2.0
125	3	160.6	20359	46.6	18.9	5.2	2.6
150	1	176.1	22284	58.0	21.3	8.2	2.7
150	2	157.4	19533	40.6	25.3	6.5	8.7
150	3	169.2	20083	42.7	21.4	12.7	3.6
200	1	170.8	20083	56.7	27.3	11.6	6.6
200	2	154.7	19533	63.6	26.3	5.5	2.3
200	3	166.2	20634	52.6	23.0	11.4	4.7
250	1	172.2	21459	54.8	27.0	13.4	6.7
250	2	165.2	22009	73.7	27.3	9.7	8.1
250	3	173.7	21734	52.8	26.2	14.7	4.6
300	1	163.8	20359	67.8	13.9	21.1	4.8
300	2	137.7	20359	66.3	17.7	19.2	3.1
300	3	167.0	22834	58.3	30.1	28.1	21.1

Table 42. Data collected at trial 15 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	156.7	23660	15.7	8.3	3.1	2.0	ND
0	2	158.7	22834	18.8	8.8	6.5	2.0	57
0	3	159.8	21734	14.8	12.4	3.7	4.0	73
25	1	166.2	21184	20.9	7.0	5.5	2.0	ND
25	2	150.9	20083	13.2	7.5	5.6	2.0	63
25	3	164.5	23935	20.8	14.0	4.9	2.9	68
50	1	160.2	23935	23.8	11.6	5.7	2.1	ND
50	2	175.3	23935	24.6	11.6	6.7	3.1	141
50	3	174.3	23110	24.9	10.9	4.6	2.0	772
75	1	173.6	24760	27.9	14.3	5.5	2.4	ND
75	2	170.7	21734	29.6	13.0	7.1	2.7	559
75	3	164.1	23660	25.0	15.7	4.4	2.2	1662
100	1	176.1	22009	29.3	10.1	5.5	3.0	ND
100	2	189.7	25036	30.6	10.3	6.6	4.8	682
100	3	179.0	24760	39.0	19.7	7.8	3.9	1663
125	1	176.5	24485	44.6	13.5	14.2	6.5	ND
125	2	172.6	20083	40.9	12.9	10.3	5.0	900
125	3	176.3	23385	48.4	12.2	18.1	3.5	1406
150	1	175.4	24210	45.8	22.7	7.5	8.4	ND
150	2	168.1	22284	33.7	19.9	7.5	6.5	1020
150	3	167.0	20909	58.0	18.8	7.4	5.7	2303
200	1	191.8	23385	53.3	11.8	24.8	7.1	5013
200	2	180.4	23385	42.3	14.2	16.9	10.2	1956
200	3	176.9	22834	38.7	14.8	9.9	7.4	1796
250	1	186.6	22284	56.3	11.4	23.1	5.2	4274
250	2	172.2	23110	52.5	10.8	13.3	3.1	1598
250	3	174.1	23660	74.5	12.5	27.1	5.4	2214
300	1	159.1	20634	65.3	20.6	8.2	6.4	2969
300	2	189.4	22284	61.7	11.0	16.5	4.3	1472
300	3	174.2	20909	62.2	15.4	12.1	8.3	1737

Table 43. Data collected at trial 16 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	152.0	19809	20.3	8.5	4.6	4.3	152
0	2	174.3	20909	19.0	10.1	4.8	2.7	405
0	3	171.1	20083	19.7	14.0	3.8	2.9	387
25	1	174.1	21734	28.1	12.2	7.0	4.5	3078
25	2	181.4	21734	30.1	12.5	4.5	2.5	2323
25	3	176.2	22009	26.5	10.7	2.7	2.0	588
50	1	163.1	21459	29.0	11.8	6.3	3.5	1822
50	2	173.8	22284	30.3	12.4	3.9	3.0	2629
50	3	182.3	21459	34.4	14.0	4.1	3.9	2749
75	1	175.1	20359	44.2	21.0	6.4	4.7	3494
75	2	175.3	22284	34.5	15.7	4.7	3.1	2608
75	3	179.4	21734	29.8	12.0	4.7	3.4	5235
100	1	184.5	23110	35.9	17.8	4.1	3.4	5244
100	2	170.1	22834	37.5	14.8	3.9	3.6	4100
100	3	183.8	20909	64.3	14.9	14.4	6.6	5941
125	1	173.3	21734	47.3	27.3	5.0	8.0	3336
125	2	178.5	22284	44.6	18.5	4.8	5.4	3363
125	3	183.7	22009	42.3	14.7	6.5	4.2	4853
150	1	172.6	21459	34.7	10.9	4.6	3.9	4114
150	2	176.4	22009	63.7	16.8	15.7	4.6	5221
150	3	168.1	21459	64.2	13.4	8.1	3.4	2750
200	1	180.3	21184	45.1	18.4	5.4	6.1	6188
200	2	181.4	22284	61.4	18.6	13.2	7.5	5038
200	3	184.1	20083	73.6	15.9	33.7	6.5	7919
250	1	192.9	22009	61.2	14.1	10.5	5.6	6979
250	2	191.2	21184	46.7	17.0	10.8	10.2	10119
250	3	179.7	22284	74.5	20.5	17.9	9.5	5259
300	1	189.6	22834	96.8	23.8	46.2	24.5	6444
300	2	164.1	21734	67.0	20.4	34.8	11.1	6979
300	3	172.1	21459	64.3	19.1	15.1	9.6	7573

Table 44. Data collected at trial 17 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	180.9	27181	8.1	10.2	5.2	6.1	289
0	2	197.8	25091	5.7	9.6	6.2	4.4	383
0	3	167.1	21257	4.0	9.0	8.5	6.0	210
25	1	187.9	25439	8.6	12.6	6.1	3.6	1015
25	2	194.9	25439	7.6	11.3	4.7	3.7	864
25	3	180.3	24742	6.1	9.2	5.0	4.1	204
50	1	187.1	25787	14.7	21.5	5.4	3.9	4452
50	2	197.3	25091	8.4	12.8	7.9	6.3	515
50	3	193.4	26136	9.0	12.5	6.3	3.8	735
75	1	191.8	22651	23.0	15.1	5.9	4.5	3245
75	2	202.4	26485	14.5	14.4	4.4	2.9	1237
75	3	190.9	26485	12.2	15.5	5.1	3.3	1013
100	1	186.7	24045	18.3	14.7	4.8	7.1	2663
100	2	190.9	24742	21.2	17.3	7.2	4.4	4721
100	3	182.3	25439	13.3	14.3	8.5	5.5	3266
125	1	193.3	25787	25.3	15.6	6.1	5.0	5745
125	2	204.9	25787	18.7	14.9	4.9	2.7	3699
125	3	194.6	25439	25.6	19.3	5.4	3.5	6524
150	1	191.4	25439	28.2	25.3	5.9	4.7	7674
150	2	196.7	26136	22.5	17.3	5.0	2.9	4724
150	3	183.4	23348	23.0	20.3	5.5	3.8	6781
200	1	193.3	26136	48.5	24.3	6.5	4.6	10199
200	2	202.9	26136	37.0	18.7	4.9	4.3	6757
200	3	194.5	26833	35.8	20.8	5.7	3.5	7662
250	1	199.6	24394	43.5	23.5	6.5	4.5	9753
250	2	195.6	26485	28.3	19.3	5.8	3.1	4532
250	3	186.2	24742	43.5	20.1	6.4	3.0	8670
300	1	192.9	28227	72.8	19.6	12.2	4.6	12475
300	2	195.3	23348	37.0	18.6	5.8	3.5	8301
300	3	207.4	25787	64.6	17.2	15.0	2.8	13758

Table 45. Data collected at trial 18 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	169.4	24742	9.6	9.9	6.9	5.5	237
0	2	170.3	19863	8.0	10.2	7.0	4.8	1831
0	3	185.9	24045	8.1	10.4	6.7	5.2	2403
25	1	169.4	21954	13.0	11.0	6.1	4.6	3119
25	2	174.2	19515	12.5	15.7	6.6	5.6	5522
25	3	174.7	24742	16.0	13.7	6.8	5.4	4147
50	1	173.4	23348	13.5	12.7	5.5	3.5	4512
50	2	186.9	25091	12.2	13.3	5.5	3.8	2333
50	3	175.1	21954	13.1	19.2	5.6	4.7	5543
75	1	175.0	22651	13.2	14.9	7.3	5.4	1826
75	2	180.0	24742	20.5	17.1	6.1	3.7	6143
75	3	175.7	22651	16.0	18.7	5.6	5.9	5747
100	1	182.2	25439	20.5	17.7	7.1	4.8	4950
100	2	181.6	24045	23.5	20.9	6.8	6.0	4743
100	3	177.8	20212	18.9	21.8	6.2	6.3	8133
125	1	181.4	23000	16.1	15.3	7.1	6.3	6392
125	2	174.3	23348	25.2	24.7	5.0	4.1	6112
125	3	179.6	23348	34.5	21.0	6.6	5.9	6609
150	1	184.4	25091	34.6	15.4	5.7	3.5	5159
150	2	172.7	22651	18.1	22.7	5.0	3.9	4381
150	3	182.9	23348	29.9	23.3	6.7	6.6	8143
200	1	180.7	25091	37.1	19.7	5.6	4.7	5374
200	2	170.8	23348	36.1	22.9	5.1	4.8	7841
200	3	176.8	21257	44.1	28.9	7.3	5.9	7228
250	1	180.2	24045	46.2	21.8	5.3	4.4	6927
250	2	174.4	23348	50.7	23.7	6.6	3.9	6372
250	3	167.1	19863	34.2	58.2	7.2	9.0	9646
300	1	180.2	21257	35.1	16.9	5.2	4.2	7518
300	2	185.5	24742	66.2	27.8	7.7	5.8	6665
300	3	178.1	20909	61.3	28.6	8.0	5.2	8487

Table 46. Data collected at trial 21 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	127.3	21257	5.9	4.7	9.5	4.9	105
0	2	164.9	25787	7.2	6.6	11.3	5.1	227
0	3	127.7	23000	6.0	5.2	7.1	6.2	110
25	1	154.8	21257	7.6	6.9	7.8	3.4	137
25	2	143.7	23697	7.2	5.6	6.6	5.2	224
25	3	144.2	23697	10.5	7.9	6.6	8.1	87
50	1	168.9	25787	13.0	8.6	6.6	3.4	228
50	2	152.5	24394	11.6	8.1	10.5	4.8	175
50	3	163.9	25091	14.6	10.5	6.7	3.2	132
75	1	173.4	23697	20.4	10.5	10.3	4.7	1199
75	2	158.0	23348	15.7	8.5	7.1	2.8	137
75	3	153.0	24394	14.2	9.6	5.4	3.9	121
100	1	162.3	22651	17.4	9.8	5.6	3.5	694
100	2	168.6	25091	29.7	10.7	8.4	9.3	2014
100	3	164.8	22303	26.1	11.6	6.7	2.7	460
125	1	157.4	22651	29.8	16.7	6.3	5.8	1002
125	2	158.2	25091	22.4	14.3	7.7	8.4	360
125	3	180.9	25439	28.0	9.7	7.4	8.8	3713
150	1	175.3	25787	27.0	15.5	6.7	4.4	2571
150	2	163.6	23697	18.5	10.7	10.7	5.5	500
150	3	170.8	21606	28.9	16.1	8.2	3.6	1705
200	1	164.6	25091	41.5	17.9	14.7	3.9	5850
200	2	177.6	21954	40.6	23.0	9.2	9.0	6617
200	3	184.5	20909	35.8	18.9	9.8	3.7	3430
250	1	172.5	22651	37.8	17.4	13.7	7.2	9203
250	2	179.5	24394	46.9	17.8	13.8	5.0	7211
250	3	182.5	21954	52.5	13.6	13.7	2.8	5881
300	1	166.4	21606	58.9	19.5	18.8	7.8	10802
300	2	173.4	22303	41.4	24.4	11.0	7.7	7826
300	3	189.6	23348	61.5	23.6	13.2	5.3	4201

Table 47. Data collected at trial 22 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	-------	-------	(ppm N)	-------	-------
0	1	149.8	21257	5.1	4.6	2.5	3.0	ND
0	2	184.6	21257	6.8	6.5	3.0	2.4	110
0	3	155.9	24394	3.7	4.6	3.0	2.1	119
25	1	166.7	19863	4.4	8.3	4.0	5.6	219
25	2	167.3	20560	10.9	7.7	3.5	2.6	ND
25	3	153.1	23000	7.9	8.9	3.1	3.3	230
50	1	171.8	23000	6.7	6.9	3.8	3.8	ND
50	2	181.3	23348	7.4	10.1	3.6	3.0	777
50	3	181.8	25091	15.3	14.9	3.4	3.1	2698
75	1	188.9	21257	7.9	10.0	3.2	2.4	ND
75	2	185.4	22651	8.4	12.7	3.1	3.6	3890
75	3	178.5	21257	18.8	12.7	3.5	2.4	4210
100	1	174.0	25091	23.0	14.3	3.3	3.3	636
100	2	185.2	24394	22.6	9.6	4.1	2.8	ND
100	3	187.9	23697	13.4	9.9	3.5	2.8	2951
125	1	173.6	23697	13.9	16.8	3.7	3.4	4109
125	2	186.8	23000	36.8	16.8	4.2	4.1	6614
125	3	187.1	22651	13.7	16.8	2.8	3.8	4779
150	1	192.7	21606	22.4	15.3	4.3	3.9	6874
150	2	192.8	21606	30.7	17.6	4.8	3.8	ND
150	3	192.9	21257	39.2	15.4	4.2	3.2	8124
200	1	189.2	25091	28.1	15.2	4.6	2.3	3465
200	2	194.9	21257	24.4	18.3	3.4	2.2	5211
200	3	189.8	22303	31.4	14.1	4.5	3.6	ND
250	1	185.6	19863	26.5	14.0	4.9	2.5	6932
250	2	203.8	22651	35.8	13.6	4.4	2.7	9524
250	3	176.0	26136	43.8	17.7	6.9	4.5	7501
300	1	190.0	20909	47.0	22.5	5.9	2.8	5188
300	2	175.5	19166	18.1	62.5	3.8	13.6	ND
300	3	187.4	21606	33.3	16.4	6.0	3.5	ND

Table 48. Data collected at trial 23 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	128.4	19747	11.0	ND	2.2	ND	65
0	2	137.7	18585	10.9	ND	2.6	ND	98
0	3	141.7	21199	6.4	ND	3.6	ND	74
25	1	113.8	16843	8.6	ND	2.3	ND	74
25	2	138.5	18876	12.3	ND	2.5	ND	278
25	3	130.5	18585	16.0	ND	2.5	ND	529
50	1	134.3	20038	24.9	ND	2.6	ND	142
50	2	139.0	18005	22.2	ND	2.2	ND	342
50	3	138.4	16262	32.4	ND	2.4	ND	1100
75	1	147.6	22942	18.6	ND	2.4	ND	937
75	2	142.6	19747	11.3	ND	2.6	ND	84
75	3	150.1	18295	30.5	ND	2.4	ND	1859
100	1	146.3	18295	21.3	ND	1.7	ND	709
100	2	149.3	20328	24.7	ND	1.8	ND	1807
100	3	140.0	19457	42.0	ND	1.8	ND	4244
125	1	128.9	20038	34.7	ND	1.9	ND	3914
125	2	142.6	20909	27.7	ND	2.6	ND	2128
125	3	145.2	18876	18.1	ND	2.9	ND	2604
150	1	154.4	19747	27.2	ND	3.2	ND	1418
150	2	138.2	19166	34.8	ND	4.3	ND	5196
150	3	131.0	18295	40.4	ND	4.9	ND	3467
200	1	149.3	20328	42.8	ND	3.1	ND	4238
200	2	144.7	17715	49.3	ND	2.1	ND	4992
200	3	142.9	18005	52.4	ND	5.3	ND	5434
250	1	136.7	18876	57.1	ND	4.1	ND	3753
250	2	146.1	20038	84.4	ND	3.7	ND	5201
250	3	143.0	18876	65.4	ND	9.4	ND	4805
300	1	138.9	22942	53.3	ND	7.9	ND	8134
300	2	133.8	18005	59.0	ND	11.2	ND	3615
300	3	141.6	18005	50.0	ND	5.8	ND	3753

Table 49. Data collected at trial 25 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	87.1	20560	10.2	6.6	2.1	2.4	1473
0	2	99.2	20560	9.3	10.0	5.0	2.8	680
0	3	95.6	23697	9.4	6.7	2.6	4.8	1734
25	1	89.1	21954	6.1	4.4	3.0	2.4	123
25	2	87.8	21954	10.2	5.6	2.4	2.7	256
25	3	101.4	19166	8.7	10.2	2.7	2.8	1533
50	1	84.0	21257	7.6	3.5	1.8	2.5	716
50	2	72.6	16030	13.4	9.4	3.8	2.3	1997
50	3	82.4	17772	9.9	6.3	2.9	2.1	917
75	1	78.3	21606	5.4	5.0	3.8	3.7	75
75	2	84.3	21606	12.4	9.0	3.4	4.4	1842
75	3	100.5	23000	13.6	8.2	2.0	1.8	2660
100	1	92.7	20212	12.3	4.5	3.7	2.4	1628
100	2	91.3	18818	13.0	9.2	2.0	2.0	2258
100	3	81.5	19166	12.2	6.3	2.4	1.6	1500
125	1	74.9	20212	7.2	7.7	2.1	23.5	92
125	2	104.5	23000	19.3	15.2	2.3	3.3	1563
125	3	104.8	23697	20.8	14.2	1.7	6.7	1441
150	1	83.7	19166	20.2	6.1	2.8	3.3	1499
150	2	88.6	21606	22.2	17.8	2.8	2.4	3013
150	3	104.2	24394	16.1	8.5	2.4	2.9	3555
200	1	92.2	20212	9.1	7.5	4.8	2.3	687
200	2	113.8	19863	20.5	6.9	2.4	3.1	1383
200	3	94.1	23000	30.7	19.6	2.3	2.7	3015
250	1	99.2	24394	17.5	18.3	3.1	6.5	2081
250	2	79.3	19863	16.2	10.3	2.8	2.9	1839
250	3	97.1	20212	32.8	10.9	2.6	3.6	7130
300	1	85.9	19863	18.1	23.2	7.3	6.6	3698
300	2	109.0	26136	30.0	6.7	3.6	3.5	3544
300	3	114.9	26833	24.4	9.5	2.3	2.3	4541

Table 50. Data collected at trial 27 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	-----	-----	(ppm N)	-----	-----
0	1	150.1	17607	7.7	6.5	5.3	6.6	756
0	2	126.6	15682	8.7	5.7	3.6	3.2	1504
0	3	127.5	16232	6.9	6.9	3.6	3.2	641
25	1	144.6	16507	10.8	8.1	4.2	4.2	1445
25	2	149.3	22009	12.1	7.2	4.5	3.4	1444
25	3	131.0	17883	15.5	6.1	3.6	2.3	1089
50	1	153.6	19533	18.7	10.8	5.8	6.6	569
50	2	140.7	14856	20.3	8.9	4.1	3.6	1774
50	3	121.0	17332	13.6	8.0	3.8	2.3	698
75	1	142.1	17883	23.6	9.3	6.1	3.2	1335
75	2	155.2	21184	20.5	8.7	3.9	3.0	411
75	3	157.7	20359	20.2	11.9	4.1	2.4	1924
100	1	127.0	19809	26.5	11.1	4.0	4.1	2359
100	2	133.8	22834	30.8	10.2	4.2	3.2	1508
100	3	147.3	18708	26.9	10.7	4.0	2.4	787
125	1	148.7	19809	30.4	12.4	4.0	5.2	2088
125	2	160.6	20634	31.9	10.7	4.8	3.5	1135
125	3	152.5	19533	35.8	9.9	7.0	3.4	2173
150	1	127.6	19533	45.1	16.3	6.7	6.5	2774
150	2	156.3	14856	27.7	10.8	4.2	3.3	2671
150	3	149.4	20359	35.9	13.0	5.7	3.2	1281
200	1	143.4	18708	48.0	15.9	8.7	5.8	2778
200	2	152.0	21734	31.6	8.6	5.6	2.6	2453
200	3	156.5	20909	27.1	12.8	6.0	3.0	3268
250	1	152.2	17883	48.1	17.5	8.0	4.5	2889
250	2	144.5	20634	54.9	22.2	13.0	5.6	4894
250	3	154.1	20634	51.3	12.8	13.1	3.8	2359
300	1	ND	ND	ND	ND	ND	ND	ND
300	2	ND	ND	ND	ND	ND	ND	ND
300	3	ND	ND	ND	ND	ND	ND	ND

Table 51. Data collected at trial 28 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	-------------	(ppm N)		-------------	
0	1	150.1	25652	10.3	6.6	4.1	2.9	111
0	2	165.4	25168	14.0	6.2	4.2	4.5	494
0	3	162.3	23716	13.4	5.8	3.9	2.5	148
25	1	144.6	27104	17.6	6.8	4.3	4.0	204
25	2	164.2	26620	19.2	10.6	4.9	3.3	181
25	3	148.6	24200	13.3	8.0	3.7	4.2	604
50	1	150.6	24200	7.5	16.4	2.0	3.5	169
50	2	157.4	25168	15.4	8.5	3.8	3.5	72
50	3	172.6	25168	24.6	9.8	5.4	4.3	1310
75	1	149.8	25168	22.4	9.8	4.1	3.0	214
75	2	161.3	25652	26.4	7.6	4.4	6.2	307
75	3	161.9	26620	23.9	9.1	3.2	4.0	541
100	1	161.1	24684	22.5	10.2	4.1	3.2	914
100	2	144.6	25168	27.5	8.0	4.7	3.1	1306
100	3	164.1	23716	26.0	20.5	5.1	4.9	1259
125	1	175.1	26136	30.9	8.2	5.1	3.1	478
125	2	173.0	25652	32.2	14.0	4.7	2.8	985
125	3	164.8	26620	56.4	9.4	9.2	3.4	2295
150	1	149.0	24684	21.6	8.9	3.5	3.6	334
150	2	164.5	26620	35.5	11.9	4.4	2.6	1478
150	3	151.7	26136	38.8	8.1	5.6	2.2	1536
200	1	170.9	26136	60.3	13.8	9.6	3.3	3170
200	2	162.6	25652	40.2	10.6	6.5	3.1	2215
200	3	144.5	26620	41.6	7.9	5.6	3.7	1812
250	1	158.2	24200	47.4	16.3	1.6	4.0	3433
250	2	162.4	24684	44.8	18.2	5.0	4.1	3574
250	3	155.7	24200	65.9	8.4	21.8	3.2	1941
300	1	133.9	24684	52.6	11.9	12.0	5.0	1193
300	2	160.1	26136	49.6	9.7	3.1	3.7	2485
300	3	161.1	26620	47.9	10.6	8.5	5.0	1057

Table 52. Data collected at trial 29 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	176.2	27530	7.9	6.6	11.3	3.6	383
0	2	166.0	27530	3.9	6.9	4.7	3.6	89
0	3	181.1	27181	5.8	6.6	4.5	2.9	ND
25	1	195.1	27879	6.6	5.1	11.6	9.7	435
25	2	193.6	26833	8.7	5.9	3.0	2.4	267
25	3	189.5	27181	10.0	6.9	2.5	3.3	ND
50	1	198.4	27530	10.1	8.2	3.2	3.3	302
50	2	182.6	28924	11.6	5.5	7.9	4.8	82
50	3	225.4	29621	15.3	8.4	4.2	2.4	ND
75	1	199.9	28575	8.1	8.5	4.4	2.7	246
75	2	196.4	26485	12.7	9.2	3.9	2.5	218
75	3	196.2	25439	13.4	7.8	2.7	4.1	ND
100	1	204.7	26833	16.8	9.1	4.2	3.1	1249
100	2	207.8	29272	13.8	11.2	4.4	2.1	578
100	3	217.2	28575	13.0	11.7	2.8	3.0	ND
125	1	214.7	26833	20.9	9.2	5.9	2.6	832
125	2	227.0	30318	17.1	10.0	8.9	9.4	1240
125	3	219.7	30318	15.2	6.2	4.7	2.5	ND
150	1	217.1	26485	35.6	7.9	10.3	4.4	1461
150	2	221.2	28575	20.8	13.2	4.3	3.9	2013
150	3	206.7	25091	31.9	11.1	4.4	3.2	ND
200	1	213.9	28227	29.6	10.4	6.5	2.5	1933
200	2	220.4	27181	34.2	7.8	5.2	3.8	3264
200	3	219.1	29272	62.5	18.7	7.2	4.2	ND
250	1	213.1	26833	33.0	9.7	3.5	6.9	2668
250	2	220.1	26136	27.7	18.2	4.3	2.0	2180
250	3	213.9	28227	50.7	13.8	3.5	3.8	ND
300	1	212.0	29621	55.9	16.6	7.0	7.6	4509
300	2	223.3	26833	57.1	11.3	30.2	7.1	3828
300	3	196.7	26136	52.6	16.2	5.6	5.1	ND

Table 53. Data collected at trial 30 for second-year corn after alfalfa

N Rate	Rep	Grain Yield	Plant Pop.	Soil Nitrate 0-12 in.	Soil Nitrate 12-24 in.	Soil Ammonium 0-12 in.	Soil Ammonium 12-24 in.	Stalk Nitrate
(lb/a)		(bu/a)	(pl/a)	(ppm N)				
0	1	121.0	25439	3.5	3.2	1.6	1.1	146
0	2	149.4	22303	4.5	3.4	2.3	1.0	80
0	3	112.7	23348	4.6	5.0	2.3	1.4	110
25	1	126.8	24742	3.7	2.9	1.1	1.0	71
25	2	135.6	25439	5.4	3.4	1.0	1.0	65
25	3	154.5	25439	9.6	5.8	2.3	2.2	90
50	1	126.3	25091	4.9	3.2	1.3	1.0	75
50	2	140.7	25439	6.7	4.6	1.9	2.2	66
50	3	178.4	27181	10.1	8.4	2.3	1.9	95
75	1	178.9	25787	4.5	3.5	2.2	2.0	66
75	2	149.9	23697	6.5	6.4	2.2	2.4	81
75	3	183.9	25091	14.5	8.6	1.3	1.0	99
100	1	162.7	23348	6.8	5.3	1.2	1.0	95
100	2	166.6	22303	11.2	7.7	3.0	1.5	103
100	3	164.7	22651	13.0	6.4	2.0	1.0	77
125	1	158.5	21606	7.9	5.8	2.6	1.0	71
125	2	162.3	22651	7.1	5.9	1.8	1.8	99
125	3	165.9	22651	11.5	6.8	3.5	2.0	768
150	1	177.5	26833	10.8	8.2	1.5	1.0	116
150	2	181.9	27879	10.1	7.7	2.2	1.0	160
150	3	178.7	27181	15.1	9.6	2.2	1.1	84
200	1	175.9	27181	15.4	10.4	3.1	3.1	3137
200	2	175.0	23348	10.9	6.1	2.2	1.0	116
200	3	188.4	26485	26.3	11.5	10.0	1.9	2666
250	1	186.7	24394	14.5	8.8	2.7	2.1	2567
250	2	172.5	25439	25.5	10.3	7.8	1.0	2565
250	3	164.9	24045	18.8	16.9	5.0	2.2	4261
300	1	183.7	26136	22.5	15.2	8.9	4.1	4110
300	2	180.3	26833	18.0	7.9	4.0	1.0	1019
300	3	180.6	26136	27.2	13.0	8.2	1.3	2507